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**Turning Rough Dreams into a Polished  
Reality? Investigating the Formation of  
Human Capital in Botswana's Diamond  
Cutting and Polishing Industry**

**Thesis submitted for the Degree of Doctor of Philosophy**

**International Development**

**Development Policy and Practice, The Open University**

**Letsema Mbayi**

**BBusSci Economics, MCom Applied Economics (University of  
Cape Town)**

**January 2013**



## **Abstract**

This thesis investigates Botswana's vision to become a downstream player in the global diamond industry by creating downstream capabilities that can continue to benefit the country when diamond mining is no longer profitable. Botswana is the largest producer of diamonds, accounting for a quarter of the world's diamond production by value. The government has used diamond revenues to foster economic growth. The diamond-led growth has however resulted in a largely undiversified economy with limited job creation. Furthermore, the country's diamond-led growth is not sustainable, with resource depletion expected to take place in the next two decades. In response to these economic challenges, the government used its supply dominance to force downstream linkages in the diamond industry. As a result the country has 21 diamond cutting and polishing firms that employ over 3000 workers, representing a tenth of employment in the manufacturing sector.

The research examines how efficiently human capital formation in Botswana's diamond cutting and polishing industry is taking place in order to create downstream capabilities that can foster the industry's competitiveness. This is done by examining the role of the education and vocational training system, industry training institutes and the firms themselves in creating the human capital required in the diamond cutting and polishing industry. This research also considers the impact of technological change on the industry's human capital requirements. The education and vocational training system was found to meet the industry's basic general human capital requirements. But due to the embryonic institutional training in the industry, the firms were found to be making investments in both industry- and firm-specific human capital. The research argues that institutional industry training needs to be strengthened, particularly in light of technological changes that may result in more industry-specific human capital requirements in the Botswana's diamond cutting and polishing industry.

## **Acknowledgements**

Looking back at the three year journey and I have to agree with my supervisor, Prof. Raphael Kaplinksy, who at the beginning told me that what I had started would be at times both an intellectually and emotionally challenging journey that would require a lot of personal motivation on my part. I am very grateful for his support and guidance throughout this journey. His belief in my abilities and the relevance of my research, as well as his constant moral and academic support provided me with the motivation I needed throughout the PhD journey. I would also like to thank my second supervisor, Dr. Rebecca Hanlin for also being a constant source of support and guidance. Before I moved to the Open University, Prof. Mike Morris and Prof. Dave Kaplan, through the Making the Most of Commodities Programme (MMCP) were instrumental in helping me start this research at the University of Cape Town. I am also grateful to the financial support provided by the Oppenheimer Memorial Trust, the MMCP and the Open University.

My family have always been an important foundation of love that reminded me as to why I had embarked on this journey. For this I am very grateful. I am also grateful to Lamperts, especially Ben, for being my family, when I was so far from the place I had first called home. Ben's intellectual and personal support helped me understand the peculiarities of the PhD journey when I was often bewildered by it. I could not have done this without him and his generosity in helping me edit the thesis. I would also like to thank my friends in London, Botswana, South Africa and beyond, for being a source of balance especially when I necessarily needed to talk about and do anything else that did not involve diamonds! I am also grateful to the staff and students at DPP for their continuous encouragements and administrative support. Lastly, this thesis would not exist had it not been for all the people who took the time to engage with me during fieldwork, providing me with invaluable insight.

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## **Lists of Acronyms**

ADJI	Afrimond Diamond and Jewellery Institute
BBC	British Broadcasting Corporation
BEDIA	Botswana Export Development & Investment Authority
BDMA	Botswana Diamond Manufacturers Association
BDVC	Botswana Diamond Valuation Company
BDVSU	Botswana Diamond Valuers and Sorters Union
BGSCE	Botswana General Secondary Certificate Examination
BIDPA	Botswana Institute for Policy Analysis
BNVQF	Botswana National Vocational Qualification Framework
BOTA	Botswana Training Authority
BPP	Best Practice Policy
CEDA	Citizen Entrepreneurship Development Agency
CAD	Computer-Aided Design
CAM	Computer-Aided Manufacturing
CIM	Computer Integrated Manufacturing
CNC	Computer Number Control
CSO	Central Selling Organisation
CSR	Corporate Social Responsibility
Cts	Carats
DMMC	Diamond Manufacturing and Management Consultancy
DRC	Democratic Republic of Congo
DTC	Diamond Trading Company
DTCB	Diamond Trading Company Botswana
EGL	European Gemmological Laboratories
GDP	Gross Domestic Product
GIA	Gemmological Institute of America
GII	Gemmological Institute of India
GJEPC	Gems and Jewellery Export Promotion Council
GLS	Grant Loan System
GTZ	German Development Agency
GVC	Global Value Chain
HRD	Hoge Raad voor Diamant
IADI	Indian-Africa Diamond Institute
ICT	Information Communications Technology

IDI	India Diamond Institute
IGI	International Gemmological Institute
IFSC	International Financial Services Centre
ISCE	International Standard Classification of Education
IT	Information Technology
JCE	Junior Certificate Examinations
KP	Kimberley Process
KPSC	Kimberley Process Certification Scheme
LEA	Local Enterprise Authority
MDGS	Millennium Development Goals
MTTC	Madirelo Training and Testing Centre
NC	Numerical Control
NER	Net Enrolment Ratio
NDP	National Development Plan
NSDC	National Skills Development Corporation
NWT	Northwest Territories
OCAAT	Oodi College of Applied Arts & Technology
OECD	Organisation for Economic Co-operation and Development
PSLE	Primary School Leaving Examinations
SADC	Southern African Development Community
SETAs	South Africa has Sectoral Education and Training Authorities
SOC	Supplier of Choice
SSV	Standard Selling Values
TEC	Tertiary Education Council
UNESCO	United Nations Education, Scientific and Cultural Organisation
US	United States of America
VAT	Value Added Tax



# Chapter 1

## Introduction

*“Yes,” said Golg. “I have heard of those little scratches in the crust that you Topdwellers call mines. But that’s where you get dead gold, dead silver, dead gems. Down in the Bism we have them alive and growing. There I’ll pick you bunches of rubies that you can eat and squeeze you a cup full of diamond-juice. You won’t care much about fingering the cold, dead treasures of your shallow mines after you have tasted the live ones of Bism.”*

- C.S. Lewis in *The Silver Chair*, which is part of *The Chronicles of Narnia*  
(1998 version: 645)

As a young girl I attended boarding school in Kimberley, South Africa, the town where the diamond rush of the late 1800s took place and led to the founding of DeBeers, Botswana’s main diamond producer. I often found myself having to sing the school song, under the close watch of the music teacher Miss Van Zyl. The first verse of the school song, sang by rows of less than eager young girls wearing horrid blazers with dark green and black stripes, went as follows (if memory serves me right):

*“The diamonds of our city, are sent across the seas”*

*“But let them go, we will strive to show, her maids are more than these”*

*“O let us learn, this praise to earn”*

*“Per labores, ad honores”* [Through labour comes honour]

Even in those formative years, it always struck me as strange that in our school song, it seemed fine that the diamonds should be let to go and sent across the seas, particularly in a



city like Kimberley, which has acute poverty and unemployment problems. At the start of the 21<sup>st</sup> Century, nearly half of the population lived below the national poverty line in the Northern Cape province, of which Kimberley is the capital (Elsenburg, 2004), and the province had the third highest unemployment rate of nearly 25 per cent in 2004 (Statistics SA, 2004). The disused open cast mine in the middle of the city, known as the “Big Hole”, was a gigantic reminder of the buoyant diamond mining activity that took place in the city at the height of the diamond rush. As most of the value-added, or processing, happened in other countries when diamond mining became less profitable, the contribution of diamonds to Kimberley’s economy diminished. When value-added or the processing of natural resources takes place in-country, this process is known as beneficiation but in the case of Kimberley, beneficiation did not take place and instead the city’s diamonds were sent to other countries mainly in Europe for processing.

At the time I was at school, Kimberley represented a city locked in time. It had developed rapidly in the late 1800s into the second largest city in Southern Africa at the time (Meredith, 2007:34) but its development had slowed down significantly in the early 1900s when diamond mining became less profitable. This always troubled me, coming from a country whose development has been spurred by diamond mining. I wondered if in generations to come Botswana would be like Kimberley and only have a “Big Hole” to remind it of a time when its diamonds were also sent across the seas.

Later on in my life in 2009, while I was completing my master’s degree at the University of Cape Town, I was asked to join the Making the Most of Commodities Programme<sup>1</sup> to

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<sup>1</sup> The Making the Most of Commodities Programme (MMCP) was a joint research programme between The Open University and the University of Cape Town, together with African partners in the Universities of Wolverhampton, Ghana, Ibadan, KwaZulu-Natal, and the Development Bank of Southern Africa. The general objective of the MMCP was to assist SSA countries to minimise the potential costs of the boom in commodity prices and to maximise the opportunities to promote sustainable growth, and to ensure widespread access to the fruits of this growth in a context of good governance. The MMCP investigated linkages in upstream and downstream commodities sectors in a number of African countries including

investigate the extent to which linkages were being created by Botswana's nascent diamond cutting and polishing industry. This gave me my first real opportunity to make a contribution to the Botswana government's ambitious plan to extract more value from its diamond industry by developing diamond processing capabilities that can continue to benefit the nation when diamond mining is no longer profitable. This project evolved into my PhD research after I found that skills posed a real threat to Botswana's plan to become a downstream player in the global diamond industry.

Botswana is a major diamond producer, being responsible for a quarter of the world's diamond production by value. For over four decades Botswana has been mining diamonds and selling them to the DeBeers Group of Companies with little value added. The revenues earned by the government from diamond mining enabled considerable economic growth and development. This economic success has seen Botswana heralded as the "Southern Star" or "a rare African success story" (The Economist, 27<sup>th</sup> May 2008). In recent years the government has sought to capture more value-added from the diamond industry, not only to boost employment but to also create a sustainable stream of revenue from the diamond industry that can continue to contribute to the economy when diamond mining becomes unprofitable in the future. In 2005, the government was able to use its supply dominance to force DeBeers to assist it in starting a local diamond cutting and polishing industry. Botswana now has 21 cutting and polishing factories, which employ over 3000 people, representing a tenth of the manufacturing sector's total employment. While these jobs have been created, it is not clear if the local workers are developing the necessary skills and capabilities needed for this industry to be efficient and sustainable. Indeed, seven years after local sales of diamonds for domestic manufacturing started, the government still does

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Angola, Botswana, Gabon, Ghana, Nigeria, South Africa, Tanzania and Zambia. See <http://commodities.open.ac.uk/mmcp>

not have a concise policy framework on how skills will be developed in the cutting and polishing industry and has made little progress in assessing the extent and nature of skills development taking place in the industry.

Based on theoretical understandings of training, this thesis aims to investigate the current training regime in Botswana's cutting and polishing industry and assess its efficiency. A second key aim is to assess the industry's future skills requirements in light of the increasing role of technology in the industry.

## **1.1. Chapter Outline**

The thesis is structured as follows:

### *Chapter 2 Are Diamonds Really Forever? Botswana and the Diamond Industry*

The thesis starts by providing the context of the research, with a description of the role that diamond mining has had in Botswana's economy since independence. The government's ambitious beneficiation strategy in the diamond industry is also described. In order to give Botswana's diamond industry global context, the chapter also describes the global diamond value chain, particularly the role of the diamond producer DeBeers in the value chain. The chapter then goes on to describe the progress that has been made towards establishing Botswana's diamond cutting and polishing industry.

### *Chapter 3 Research Questions and Methodology*

This chapter describes the specific questions that are investigated in the research. The chapter also presents the methodology used in this thesis to collect data, which included the collection of data from primary and secondary sources. Primary data was collected during fieldwork in Botswana, India, Israel and London, whilst secondary data was collected from publicly available documents and databases.

#### *Chapter 4      Human Capital: Rents, Formation and the Impact of Technological Change*

This chapter starts with a brief description of value chain analysis and the role of rents in determining successful participation in global value chains. This helps to explain how Botswana's resource rents enabled the country to force downstream linkages. Since the country's resource rents will diminish over time as diamond mining becomes less profitable, human resource rents will be crucial in aiding value chain upgrading and sustaining the competitiveness of Botswana's cutting and polishing industry. This chapter reviews human capital literature in order to gain a theoretical understanding of training and how theory predicts training to take place in an economy according to Becker's (1964) classification of general and specific (firm and industry) human capital. This understanding is reinforced with empirical evidence on how training has been found to take place in different economies, considering the roles of various actors, such as governments, training institutions, and firms in training. Since the cutting and polishing industry is a classic example of a traditional craft industry, the chapter also reviews the skills literature, in order to understand how technological changes have affected skills in other manufacturing industries that are based on traditional craft skills.

#### *Chapter 5      The Human Capital Requirements of Diamond Cutting and Polishing Firms*

In order to investigate training in Botswana's diamond cutting and polishing industry, it is important to understand the skills required by the industry. Thus this chapter discusses the skills required by the firms for the different jobs in production and in other functions of the firm.

## *Chapter 6 Human Capital Formation in Botswana's Education and Vocational Training System*

This chapter uses primary and secondary data sources to investigate the ability of Botswana's education and vocational training system to meet the needs of the diamond cutting and polishing industry. This is done by examining how the different levels of the education system (primary, secondary and tertiary) function and the types of human capital that are produced in system, in relation to the types of human capital required by the diamond cutting and polishing firms from the system.

## *Chapter 7 Human Capital Formation in Diamond Cutting and Polishing Industry Training Institutes*

This chapter describes the role of institutional training during the various phases of the development of Botswana's diamond cutting and polishing industry. Since institutional training is found to still be embryotic, the chapter also investigates the role of institutional training in India's developed cutting and polishing centre, which is the largest in the world. This is done to shed light on how institutional training might be developed in Botswana's diamond cutting and polishing industry.

## *Chapter 8 Human Capital Formation in Diamond Cutting and Polishing Firms in Botswana*

This chapter uses primary data analysis to investigate the role of the diamond cutting and polishing firms in human capital formation. It considers how training takes place in the firms and the types of skills that this training produces. Since the firms are found to be training workers in skills that are transferrable to other firms in the industry, this chapter also investigates the different strategies that the firms have developed to mitigate the loss of workers to other firms.

*Chapter 9      Assessing the Efficiency and Future of Training in Botswana's Diamond Cutting and Polishing Industry*

This chapter provides an overall analysis of the research findings by assessing the efficiency of Botswana's training infrastructure based on insights from the literature on training in Chapter 4. The chapter also looks towards the future of training in Botswana's diamond cutting and polishing industry by investigating the technology changes that have and are taking place in the global diamond cutting and polishing industry. The chapter then discusses the implications of these changes on Botswana's diamond cutting and polishing industry's training requirements.

*Chapter 10      Conclusion*

This chapter summarises the research findings and the conclusions that can be drawn from these findings. The chapter also discusses the policy implications, the knowledge gaps that need to be filled in order to enable an evidenced-based policy response, as well as the role of the relationship between the government and industry on policy implementation.

## **Chapter 2**

# **Are Diamonds Really Forever? Botswana's Economy and the Diamond Industry**

## **2. Introduction**

This chapter provides the background and context of the thesis. The chapter starts by discussing the role of diamond mining in Botswana's economic development as well as the challenges faced in the economy, particularly as a result of the mature diamond mining industry. The chapter also provides the global context of Botswana's diamond industry by describing the global diamond value chain, the key players in the chain, particularly the role of the producer DeBeers in value chain. Value chain analysis provides useful tool to understand the sequence of stages that take a product from raw material, to production and eventually to the final consumer.

The value chain describes the full range of activities, which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use. (Kaplinksy and Morris, 2001:4).

At each stage of the value chain, various inputs such as labour and capital are used to add value to the product. The different stages of the value chain are divided into upstream activities, which involve the extraction of primary products or raw materials, and downstream activities, which are activities that involve the processing of these raw materials into secondary or manufactured products, as well the sale of these products to final consumers. In the case of the diamond value chain, upstream activities are exploration

and mining, whilst downstream activities are cutting and polishing, jewellery manufacturing and retail. Once the global context has been set, the chapter discusses the Botswana government's vision to capture more value addition in the diamond value chain. The section describes the progress the country has made in moving up the value chain and developing downstream capabilities that can continue to benefit the country when diamond mining stops being profitable.

## **2.1. The Role of Diamond Mining in Botswana's Economic Development**

Botswana is a landlocked country in Southern Africa and its economic development has been underpinned by the discovery and exploitation of diamonds. Botswana has achieved independence from Britain in 1966 after becoming a British Protectorate in 1885. At independence Botswana had an overwhelmingly poor economy and was one of the poorest countries in Africa (Siphambe, 2007:1). The largely rural population depended heavily on the agricultural sector. The discovery of diamonds around independence by a geologist working for the DeBeers Group of Companies and the prudent management of diamond revenues that followed enabled the development of the country.

It is commonly accepted in economics that resource-abundant economies tend to grow less rapidly than resource-scarce economies and the phenomenon is often referred to as the "resource curse". Sachs and Warner (1997, 2001) used regression analysis across 97 countries to show that for the period 1970-1989 resource abundance, measured as the share of primary resources in GDP, was negatively correlated to GDP growth. A number of channels have been identified to explain how resource abundance may negatively affect growth, such as, the Dutch Disease (see Sachs and Warner, 1997, 2001), the effects of resource endowment on the incentive to create human capital (see Gylfason, 2001 and Sachs and Warner, 1997, 2001), the declining terms of trade for commodities (see Prebisch and Singer, 1950 in Sachs and Warner, 1997, 2001), the volatility of commodity prices, the

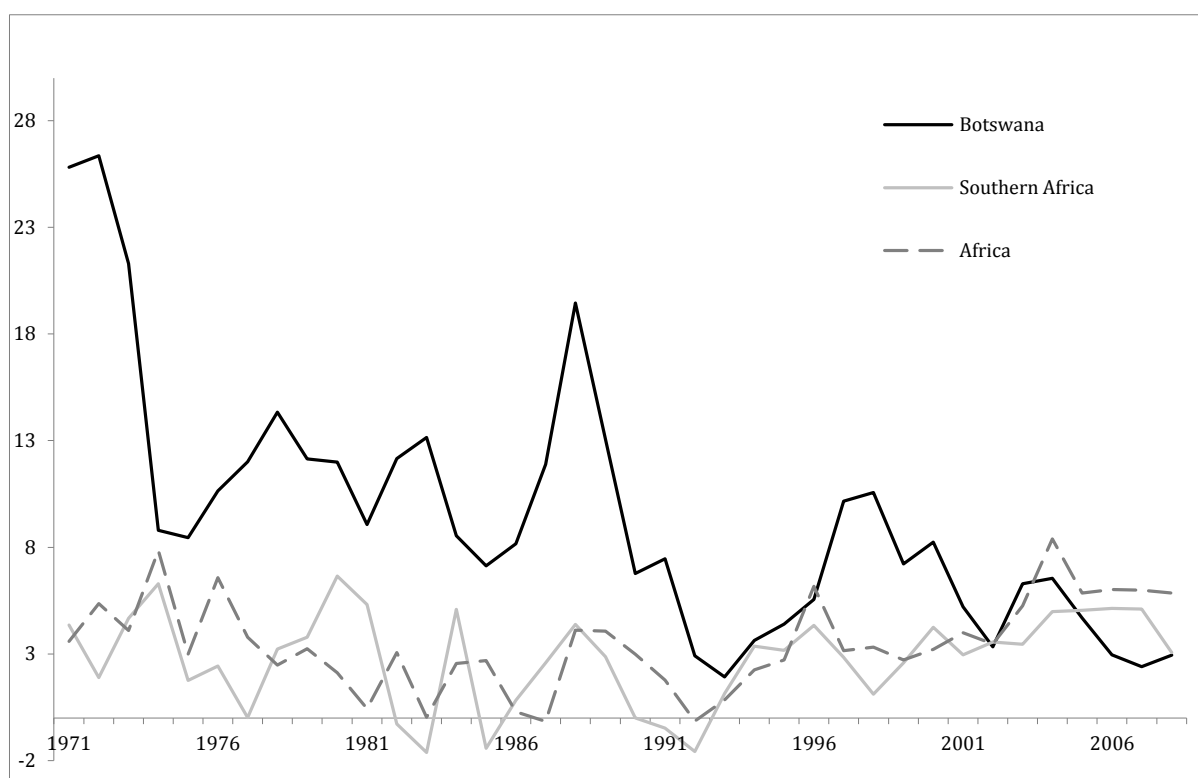


effects of resource endowment on the policy incentives and rent seeking behaviour (see Ross, 1999 and Rosser, 2006 for reviews of the resource curse literature).

Botswana represents an exception to the "resource curse" rule by managing to transform mineral wealth from diamonds into economic growth. A large body of literature exists to explain how Botswana escaped the resource curse. For example Limi (2006) argues the importance of good governance in facilitating economic development and Siphambe (2007) argues that policy coherence played a key role in channelling mineral revenues into economic growth. The discovery of diamonds in Botswana was followed by effective economic management for over four decades and bolstered by political stability, mature democratic processes, good policies and strong institutions (World Trade Organisation, 2010:96). Diamond revenues financed key infrastructure development, particularly roads, schools and hospitals, and provided an extensive welfare system to the country's population of about 1.9 million, of which more than half is now urbanised. Botswana impressive natural resource management and growth record has seen the country dubbed as 'Africa's success story' (Acemoglu, Johnson, and Robinson, 2002).

Figure 2.1 shows how Botswana's gross domestic product (GDP) grew from 1971 to 2008 compared with the African and Southern African region in the same period.

**Figure 2.1: Gross Domestic Product (GDP) growth in Botswana, Southern Africa and Africa**



Source: Data from the World Bank Country Statistics for Botswana and United Nations Aggregates Database for Southern Africa and Africa, chart by author

Botswana enjoyed positive GDP growth for the entire period and performed much better than Africa and Southern Africa. Botswana GDP growth was most impressive in the 1970s and 1980s but started slowing down in the early 1990s. In the early 2000s, for the first time in the period, Botswana started growing slower than Africa mainly as a result of the maturity of the diamond industry together with improved average GDP in Africa.

Despite the currently lower rate of GDP growth, it is important to emphasise that in the period 1960 to 2005 Botswana was one of the fastest growing countries in the world, being one of only 13 countries that had a consistent growth rate in excess of 7% per annum for more than 20 years (World Bank, 2008:26). However, despite this GDP growth and rising living standards built largely on diamond mining, employment has remained low. To

illustrate this, Table 2.1 shows GDP per capita and unemployment for selected years. In 1965, Botswana GDP per capita was only US\$77 and the unemployment data for the same year is not available. By 1985, GDP per capita had risen to US\$960 and unemployment was 26 per cent of the total labour force. In 1995, per capita GDP had increased even further to US\$3080 but unemployment had only decreased to 22 per cent. In 2005, per capita GDP had increased further still to US\$5716 but unemployment has risen to 32 per cent. Thus the development spillovers from diamond mining are significant for per capita GDP but not employment. This is because diamond mining is a capital-intensive activity that has limited employment creation.

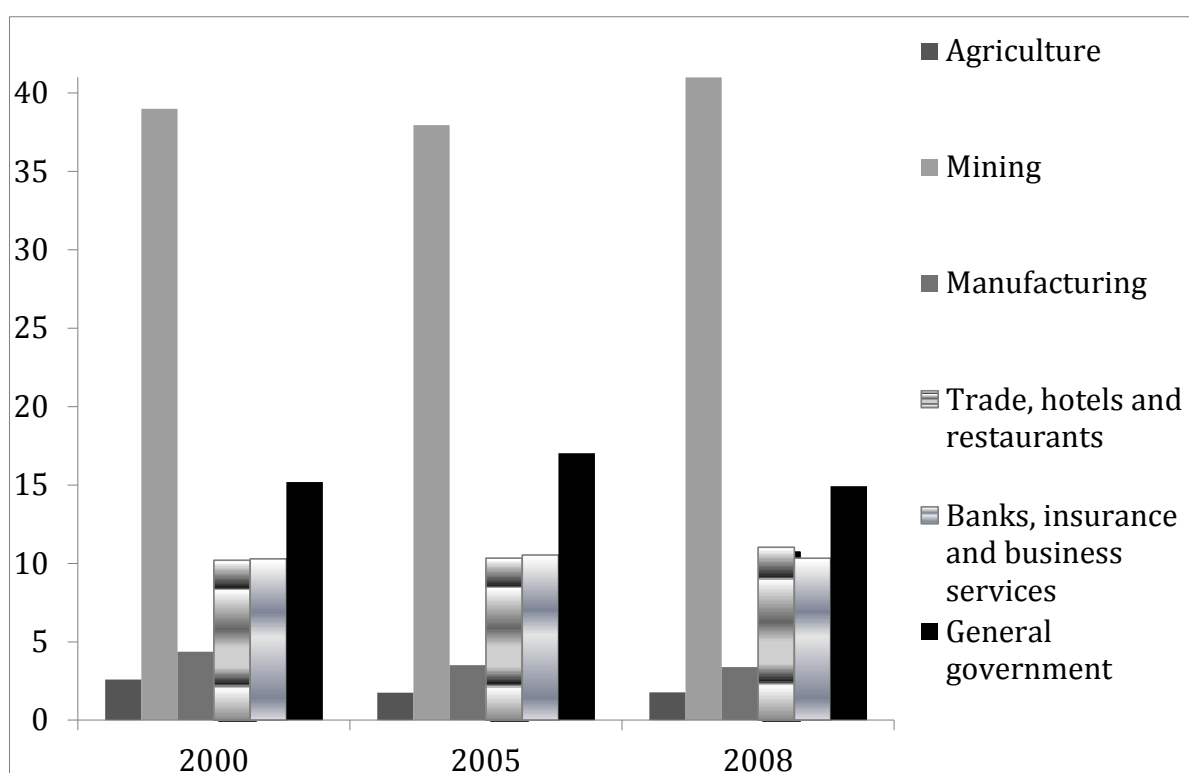
**Table 2.1: Gross Domestic Product (GDP) per capita and the unemployment rate for selected years**

<i>Indicator</i>	<i>1965</i>	<i>1985</i>	<i>1995</i>	<i>2005</i>
GDP per capita (current US\$)	US\$77	US\$960	US\$3080	US\$5716
Unemployment (% of total labour force)	-	26%	22%	32%

Source: Data from the World Bank Country Statistics

Botswana's diamond-led growth has resulted in an undiversified economy dominated by diamond mining and public spending financed largely by diamond revenues. Figure 3.2 shows the percentage contribution to GDP by selected economic activities to illustrate the dominance of diamond mining in Botswana economy.

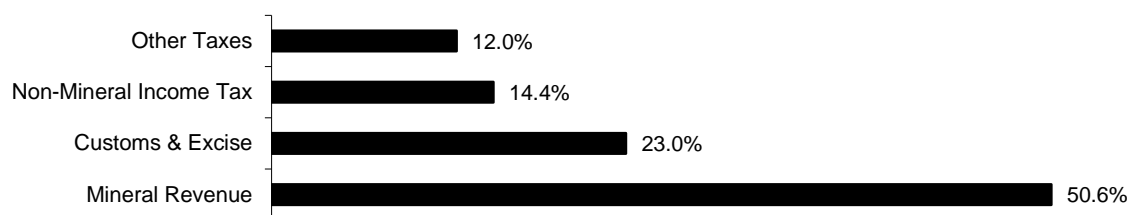
**Figure 2.2: Contribution (%) to gross domestic product by selected economic activities**



Source: Data from the Central Statistics Office and chart by author

Although Botswana does mine other minerals (copper, nickel, gold and soda ash) diamond revenues represent more than 90 per cent of all mining activities. Between 2000 and 2008, mining represented 40 per cent of GDP. The share of mining activities was followed by government activities, which contribute about 16 per cent to GDP. The tourism sector (trade, hotels and restaurants) and the financial sector (banking, insurance and financial services) are the next most important sectors in Botswana contributing about 10 per cent to GDP each. The manufacturing sector plays a very small role in Botswana economy contributing less than 5 per cent to GDP. The agricultural sector, which as noted earlier, was the main form of economic activity at independence, now contributes less than 3 per cent to GDP. Diamond mining is the key source of government finances with mineral revenue contributing half of government revenue in the last decade (see figure 2.3).

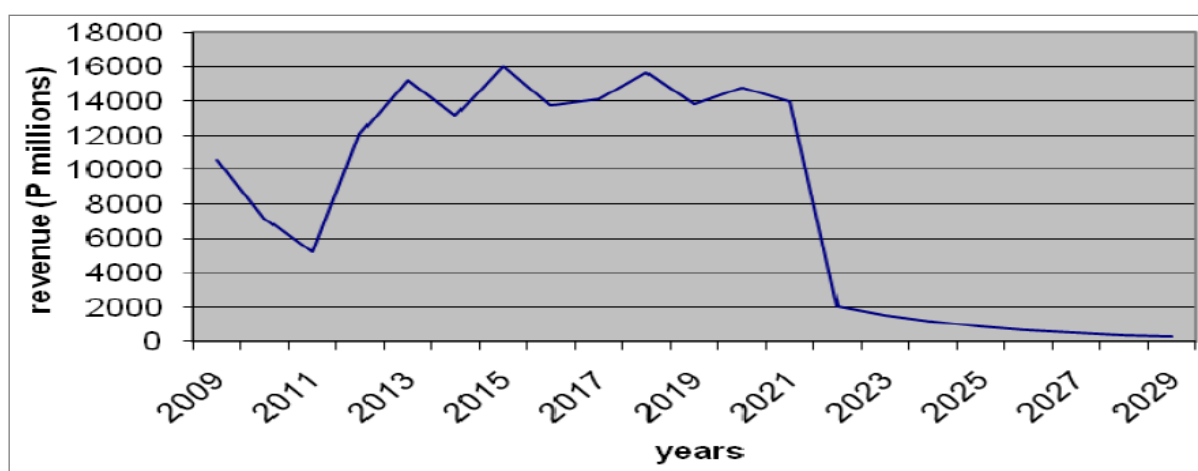
**Figure 2.3: Composition of government revenue (2000-2009)**



Source: Data from the Central Statistics Office, graph by author

However, Botswana's diamond-led growth is under threat as the government expects diamond revenues to start decreasing in the next decade when opencast mining will be replaced by underground mining. The cost of underground mining is higher than open cast mining and this will decrease the revenues accruing to government (Government of Botswana, 2009:6).

**Figure 2.4: Projected government revenue from diamonds (2009 - 2029)<sup>2</sup>**



Source: Government of Botswana (2009)

Unless there are major new discoveries, diamond mining is expected stop being profitable by 2029 as a result of resource depletion. Thus as a result, government revenue from diamond mining will decline, at first slowly and then rapidly over the next two decades (see figure 2.4). However, the likelihood of new discoveries is high given current

<sup>2</sup>In Pula current prices, the Pula is the local currency which is roughly P6 to the US\$1

exploration activities and the extension of the lives of the current mines. The next section discusses Botswana's diamond mining industry in more detail in order to understand these and other issues faced by the industry.

### **2.1.1. Botswana's Diamond Mining Industry**

Botswana produces over 30 million carats of diamonds per annum with a value of about US\$3 billion (see Table 2.2). There was a large drop in diamond production in 2009 as a result of the economic recession that impacted on diamond jewellery sales and fed through the value chain in the last quarter of 2008. All diamond mines in Botswana halted production at the beginning of 2009 and to date two mines<sup>3</sup> have not re-started production. Botswana's average value per carat is between US\$80 to US\$100, which includes both gem, and industrial diamonds. Industrial diamonds are worth considerably less than gemstones and if they were reported separately, the figure would give a more accurate value per carat for Botswana's gemstone production.

**Table 2.2: Botswana's diamond production**

<i>Year</i>	<i>Production</i>		
	<b>Volume (Cts)</b>	<b>Value (US\$)</b>	<b>US\$/ Cts</b>
2004	31,036,367	2,576,018,461	\$83.00
2005	31,889,771	2,890,079,390	\$90.00
2006	34,293,401	3,207,570,684	\$93.53
2007	33,638,000	2,960,144,000	\$88.00
2008	32,276,000	3,273,001,000	\$101.41
2009	17,734,000	1,436,454,000	\$81.00

Source: Kimberley Process

<sup>3</sup> Damtshaa and Lerela (see Table 2.5)

Botswana's diamond value chain starts with exploration to find a viable diamond deposit for mining. Diamonds are found in a particular type of rock formation known as kimberlite pipes. Exploration is a high-risk activity that requires a long-term commitment to find an economically viable diamond deposit and it can result in high rewards. In the early stage exploration or discovery phases the first step is to decide where to explore and, through a combination of techniques, identify targets for subsequent phases. Once a promising diamond deposit has been identified a number of specific methods to further assess and develop it follow. Botswana's first diamonds were discovered by DeBeers after close to 12 years<sup>4</sup> of prospecting. According to Botswana's second president, Sir Keitumile Masire, the discovery was actually made a couple of years before independence but at the time Botswana was still negotiating its independence from Britain so the discovery was kept secret and only announced after independence was achieved in 1966 (Masire, 1999).

Before the announcement was made the government changed the law to ensure that it, rather than individuals or tribal landowners, was the custodian of the all the country's minerals. This gave the government the ability use the country's mineral wealth for national development.

There is still significant diamond prospecting taking place in Botswana more than four decades after the first discovery was made. In 2009, the Department of Geological services had issued 1124 prospecting licenses for all mineral prospecting and the biggest share of these licenses, over 35 per cent, were for diamond prospecting (see Table 2.3).

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<sup>4</sup> DeBeers started prospecting in Botswana in 1955

**Table 2.3: Current prospecting licenses in Botswana (2009)**

<i>Commodity</i>	<i>Number of Licenses</i>	<i>Percentage of total</i>
Diamonds	397	35.3
Energy	250	22.2
Metals	246	21.9
Radioactive	155	13.9
Industrial	76	6.8
<b>Total Licenses</b>	<b>1124</b>	<b>100</b>

Source: Department of Geological Services, Government of Botswana

There are over 50 companies that are involved with diamond exploration in Botswana with at least four kimberlites currently undergoing advanced prospecting stages (see Table 2.4).

**Table 2.4: Advanced diamond prospecting activities**

<i>Kimberlite</i>	<i>Ownership of Prospecting License</i>	<i>Stage</i>
BK16	Firestone	Advanced prospecting
Tsabong	Firestone	Advanced Prospecting
AK8	African Diamonds	Advanced prospecting
AK9	African Diamonds	Advanced prospecting

Source: Authors research

Once a viable diamond deposit has been found, the next stage of the value chain is mining. All diamonds in Botswana are extracted by open-pit mining, where diamond deposits are close to the surface of the ground. However, as shall be explained later in this section, Botswana first underground mine is due to open soon.

Table 2.5 shows current diamond mining activities in Botswana. DeBeers operates four mines in Botswana which include the Jwaneng mine which is the most profitable diamond



mine in the world<sup>5</sup>. These mines are operated by a joint venture between the government and DeBeers, known as the Debswana Mining Company and account for almost all of Botswana's diamond production. The government also owns 15 per cent of DeBeers. Until recently 45 per cent of DeBeers was owned by the Oppenheimer family and the remaining 40 per cent by Anglo-American. However, late in 2011, the Oppenheimer family announced that it would be selling its share to Anglo-American for US\$5.1 billion (Anglo-American Press Release, 4<sup>th</sup> November 2011). The government had the option to increase its share in DeBeers by 15 per cent but chose not to use this option, largely because exercising the option would have cost \$1.255 billion during a time when the government's budget is in deficit (Miningmx, 31<sup>st</sup> July 2012).

**Table 2.5: Botswana's diamond mining activity**

<i>Mine</i>	<i>Ownership Structure</i>	<i>Start of Production</i>	<i>Sales Channel</i>	<i>Production and Lifespan</i>
Orapa	Debswana, owned 50% by DeBeers and 50% by the Government	1971	DTC	17million cts/pa -
Lethakane		1975	DTC	1million cts/pa 6 years
Jwaneng		1982	DTC	13million cts/pa 21 years
Damtshaa		2003*	DTC	31 years lifespan, 300 000 cts/pa or 5million carats over lifespan
Lerala	100% DiamonEx	2008*	Independent	330 000 cts/pa 12 year lifespan
BK11	100% Firestone Diamonds	Mid 2010	Independent	1 million cts/pa 10 year lifespan
AK6	Boteti Mining, owned 28.381% by African Diamonds, DeBeers 66.215% and Debwat 5.404%	End 2011	DTC	7 year lifespan, 600 000 cts/pa for first 3 years 880 000 cts/pa for remaining 4 years
Gope	Gem Diamonds	Still to be	Independent	1million cts per annum or 30

<sup>5</sup> The Jwaneng mine has a high rate of diamond extraction, combined with high quality diamonds that fetch high per weight prices, which make it the most profitable diamond mine in the world based on the value and quantity of recovered diamonds.

	announced	million carats over entire lifespan 30 year lifespan**
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\* These mines are still under care and maintenance since production was suspended in early 2009 as a result of the economic recession. \*\* This is the estimated lifespan, Gem Diamonds is planning a phased approach to the construction of the mine with an underground mine planed to improve the company's knowledge of the ore body (Mmegi Newspaper, 18<sup>th</sup> March 2011).

Source: Authors research

Debswana produces more than 30 million carats a year, about 22 per cent of the world's output. Debswana contributes significantly to Botswana's economy, producing over 70 per cent of the country's export earnings, 40 per cent of GDP and 50 per cent of government revenue. The government receives over 80 per cent of all gross profits realised by Debswana, making the company the single most important source of government financing. Debswana's contribution to employment is not as significant as its contribution to government revenues as its mines are capital intensive. In 2008, Debswana employed 6500 people of which 95 per cent were citizens of Botswana, making the company the second largest employer after government. The De Beers' subsidiary, the Diamond Trading Company (DTC) International, purchases Debswana's production at around a 10 per cent marketing discount on its Standard Selling Values (SSV)<sup>6</sup>, which is the figure used for exports statistics (and the Kimberley certificates) (Even-Zohar, 2007:68). In other words, Debswana sells all its output to DTC International at around 10 per cent less of production value to pay DTC International for marketing its diamonds.

Debswana's Orapa and Jwaneng mines are the most important with Jwaneng contributing 70 per cent to Debswana total earnings and Orapa having the biggest kimberlite pipe in the world. However, both these mines are old and nearing depletion, which the government

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<sup>6</sup> The DeBeers price book is the price list used to price it producers production.

expects to take place in the next two decades. To prolong the life of its richest mine, Debswana has recently completed the Jwaneng Cut 8 Project (see box 2.1).

**Box 2.1: Jwaneng Cut-8 Project – extending the life of the most profitable mine**

**Adding Seven Years to the Super Pit**

The Jwaneng Cut-8, is a key component of Debswana's North Star strategy and is the largest ever single capital commitment in the private sector in Botswana (Miningmx, 21<sup>st</sup> March 2011). The project, which was approved by Debswana in 2009, will extend the life of the Jwaneng mine by seven years and ensure profitable and continuous production at the mine to at least 2025 (Miningmx, 21<sup>st</sup> March 2011). Debswana is investing \$500m in capital expenditure and, taking into account all project stages - including feasibility, design, implementation and mining operations, as well as the cost of plant and equipment - the estimated project investment is likely to total \$3bn over the next 15 years (Miningmx, 21<sup>st</sup> March 2011). According to information provided on the DeBeers website, at its peak the project created more than 1,000 jobs. The development will require the removal of over 700 million tonnes of waste between 2010 and 2024, exposing an additional 78 million tonnes of diamond bearing ore, and deepening the Jwaneng pit to a depth of 650 metres (Miningmx, 21<sup>st</sup> March 2011). It is anticipated that this will create access to a further 95 million carats, which could be worth in excess of \$15bn over the life of the mine (Miningmx, 21<sup>st</sup> March 2011).

Furthermore, DeBeers has a revenue optimisation strategy, within which diamonds are only mined when the demand exists, that is why all Debswana mines stopped production during the recession. DeBeers holds 10 prospecting licences in Botswana and spends US\$ 4 to US\$ 5million a year on finding new deposits in the country and the company is confident of prolonging diamond mining in Botswana beyond the 20 years of prevailing forecasts. The De Beers Exploration Manager for Southern Africa, Mike Roberts, said:

“There are chances of finding another Jwaneng or Orapa, particularly in the western part of the country which is sand covered, such as in the Kalahari” (Mmegi Newspaper, 11<sup>th</sup> March 2011)

Historically, Debswana mined all diamonds in Botswana (since the DeBeers Group of Companies had made the discoveries that led to these mines) but recently new producers have started independent diamond mines in the country. The Lerala Mine owned by DiamonEx was the first independent mine in Botswana outside of the

DeBeers/Government ownership. The mine started production in 2008 but production was suspended in early 2009 as a result of the economic crisis that started in the fourth quarter of 2008. Currently the Lerala Mine and Debswana's Damtshaa mine are still under care and maintenance. Another independent mine was started last year by Firestone Diamonds and the Boteti Mining Company is currently constructing the third independent mine with a majority shareholding by DeBeers.

Lastly, the proposed Gope mine located in the Central Kalahari Game Reserve has attracted a lot of media attention due to an on going dispute between the government and the indigenous people of the Kalahari, commonly known as the "Bushmen" or "San", who have inhabited the reserve for centuries. The government sought to move the "Bushmen" from the reserve stating that their way of life was no longer compatible with wildlife conservation. The "Bushmen" subsequently took the government to court with the help of Survival Africa, which felt the "Bushmen" were only being removed to make way for diamond mining. The "Bushmen" won the legal dispute and were let back into the reserve. DeBeers and Xstrata, who initially owned Gope, sold it Gem Diamonds in 2007 for US\$34.1 million (Mmegi Newspaper, 18<sup>th</sup> March 2011) due to all the negative media attention it was attracting. Amongst all the controversy, Gem Diamonds was awarded a mining license early in 2011 and mining is set to commence. In July 2011, Gem Diamonds renamed Gope to Ghaghoo Diamond Mine, which reflects the local name for the area. Due to the thick sands of the Kalahari Desert this will be the only underground diamond mine in Botswana when it is operating.

Unlike the Debswana mines, the government has no direct ownership in the independent mines and these mines were licensed on condition that their rough diamond production is traded locally. It is not clear why the government has changed its strategy in terms of the ownership of the new diamonds mines. The new mining licences state that the companies

will be required to pay a diamond royalty of 10 per cent on the gross market value of production from the mines (Government of Botswana, 2008). All the new producers except Boteti will sell their diamonds outside of the DeBeers channels. All diamonds mined by Boteti Mining Company will be sold to the DeBeers subsidiary, the Diamond Trading Company (DTC) International. At the end of 2010, Firestone Diamonds traded its first rough diamonds in Botswana through a tender process. More than 30 diamond buyers attended the tender from Belgium, Israel, India, Russia and southern Africa (Mining Weekly, 1<sup>st</sup> December 2010). This was the first time rough diamonds were sold independent of DeBeers' marketing channel in Botswana.

The next section discusses Botswana's beneficiation strategy, which aims to extend Botswana's diamond value chain beyond diamond mining and diamond sorting and valuation activities to include downstream activities.

## **2.2. Botswana's Diamond Beneficiation Strategy and Development Policy**

The government has decided it is crucial that Botswana uses its remaining diamond resources to foster long-term economic growth through the private sector, to create fiscal sustainability and to make the most of the remaining diamond deposits in light of approaching resource depletion (Tombale, 2008 and Government of Botswana, 2009). The beneficiation imperative in the diamond industry argues that cutting and polishing of diamonds locally will further local economic development ensuring that a greater proportion of value derived from diamond exploitation will stay 'in country' and benefit local communities, through increasing skills and employment.

Although Botswana has benefited from its diamond-based growth path through its partnership with DeBeers, the imperative question within the government is whether the country have benefited more under a different arrangement with DeBeers that allowed for

greater value added (Interview, Gaborone: 29<sup>th</sup> October 2009). The limited employment spillovers in the current growth path has meant that many locals still live in poverty despite the high GDP per capita and Botswana being classified as a middle-income country. Thus a desire to create jobs is one of the factors driving the government's beneficiation policy. Historically, a number of government officials have questioned whether the DeBeers arrangement allowed the country to take full advantage of its diamond resource and whether beneficiating the country's diamonds would not lead to greater local economic benefit through job creation. For example David Magang, the former Minister of Minerals, Energy and Water Affairs, argued in speech at the 2<sup>nd</sup> Financial Times conference in 1997 Botswana's diamond industry needed to generate more value added.

However, there is considerable doubt amongst economists as to whether beneficiation is based on sound economic theory and whether it is a good policy framework to promote exports. The main economic argument for beneficiation is based on transport costs, stating that in the case of high transport costs it makes economic sense for the commodity to be processed where it is mined. However, this argument does not apply in the case of diamonds as they are lightweight and do not face high transport costs relative to other minerals. Hausmann, Klinger and Lawrence (2007) argue that beneficiation is a bad policy, as it makes no sense conceptually, and is completely inconsistent with international experience. This conclusion is based on quantitative analysis that found that factor intensities (activities that require relatively more of a specific input like capital or labour) do a better job of explaining patterns of production and structural transformation than forward linkages (when the products of one industry are used as the inputs in another industry). This, as they explain, is because the factors needed in different segments of the value chain are often very different, thus capabilities in extractive industries will not result in capabilities in processing industries. Indeed, it is yet to be shown that the beneficiation policy can be successful in creating sustainable export sectors in Botswana.

Despite this the Botswana government, like many other governments<sup>7</sup>, is of the opinion that the beneficiation of diamonds can result in new and deeper linkages with the local economy that maximise local involvement by developing new capabilities. The government seeks to take full advantage of this opportunity through the beneficiation policy, which is part of the current minerals policy. Through the beneficiation of diamonds the government plans to prepare Botswana for a 'life after diamonds' by creating downstream competencies that can continue to be utilised when diamond mining is no longer profitable in Botswana (Government of Botswana, 2009). The government's diamond beneficiation strategy is a four pronged strategy that aims to create downstream competencies in the cutting and polishing industry, jewellery manufacturing industry, diamond trading industry and ancillary businesses. The first part of the beneficiation strategy and the focus of this thesis is on the creation of a viable cutting and polishing industry.

Even before resource depletion became such a prominent concern, the government had already attempted to start a cutting and polishing industry in the early 1980s, mainly as a way of creating more employment opportunities in the diamond industry. At the time DeBeers did not support the government's ambitions, arguing that cutting and polishing activities were not economically viable in Botswana. Mild pressure from government on DeBeers led to the start of three cutting and polishing factories between 1980 and 1990 (Interview, Gaborone, 29th October 2009). However, none of these factories ever reported a profit and critics have gone as far as saying that the companies reported a loss in order to keep perpetuating the DeBeers' notion that beneficiation was not viable in Botswana (Interview, Gaborone, 29th October 2009).

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<sup>7</sup> Namibia, South Africa and Canada also have beneficiation policies for their diamond industries.

Despite this failed attempt at establishing a cutting and polishing industry some learning took place within government and it continued to push DeBeers for beneficiation. Botswana's real opportunity came in 2005 when DeBeers' 25 year mining license was due for renewal. The government had a lot of bargaining power due to the significance of Debswana's production in DeBeers' global production. In 2005, Botswana accounted for about 60 per cent of DeBeers' supply of rough diamonds (Even-Zohar, 2007:46). The government insisted that in order for DeBeers to renew its mining license for another 25 years it should help Botswana in creating a viable cutting and polishing industry.

“Nearly 50 years ago, when DeBeers, run by the Oppenheimer family, made its first discovery of diamonds in Botswana, fed its own bottom line and led the country to economic glory, it probably did not realise that one day it may be pressured by the new found confidence of the Botswana government, who having understood the game, resisted the autocratic systems of De Beers and now seems to be holding the whip and pushing for more returns from diamonds and De Beers” (Diamond World News Service, 22<sup>nd</sup> October 2012).

DeBeers gave in to the government's demands realising that it could no longer hold back beneficiation in Botswana and signed the new mining contract which included the following three agreements: (1) a renewal of the mining licences for Debswana for 25 years, (2) the sale of Debswana's production to the Diamond Trading Company (DTC) International for another five years; and (3) the establishment of DTC Botswana (DeBeers, 2007). DTC Botswana is responsible not just for sorting and valuing Debswana's production but also for the sale of rough diamonds for local manufacturing. These agreements lay the foundation for the government's vision to increase job creation and value addition from the country's diamond resource.



Diamond manufacturing can be divided into two categories that depend on the size of the rough diamonds being processed and utilise different production methods (Watermeyer, 1980). The first is the manufacture of small diamonds of less than one carat in weight and the second is the manufacture of larger stones that weigh more than a carat. The first category is very dependent on production cost, especially as diamond sizes become even smaller making the production of small diamonds only profitable in low cost environments. In contrast, bigger stones are more dependent on skills than production costs and workers that process larger diamonds need to be trained to have a very high degree of skill (Watermeyer, 1980). The Government's vision for the local cutting and polishing industry is to add value to larger rough diamonds bigger than one carat, so as to not compete with low cost cutting and polishing centres in Asia, particularly India and China.

Botswana current economic development policy is discussed next in order to understand how the diamond beneficiation policy fits into the nation's overall economic development plans.

### **2.2.1. Botswana's Development Policy Framework**

Botswana's economic development is guided by 6 year national development plans. The current National Development Plan 10 runs from 2010 to 2016 and is the country's key development policy. With the theme of "Accelerating Vision 2016<sup>8</sup> Through National Development Plan 10", it adopts a broad, multi-sectoral and long-term approach, which also considers social and human development issues. Like the previous National Development Plan 9, the strategic thrust of the National Development Plan 10 is to strengthen economic diversification away from diamond mining towards private sector growth. The previous plan had little success in achieving economic diversification. The

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<sup>8</sup> The government in 1996 adopted "Vision 2016," envisioning the transformation of Botswana into "an educated and informed nation" as well as "a prosperous, productive and innovative nation" as two key cornerstones of the strategy.

National Development Plan 10 aims to prepare the country for 'life after diamonds' by creating an optimal business environment and developing a skilled labour force to build a knowledge-based economy to achieve diversification through a private sector-led economy.

The government aims to grow the private sector by removing all bottlenecks and constraints to private sector development by addressing the infrastructure needs of the private sector and intensifying investment in education and training to provide the skills needed by the private sector. The Government has identified human resource development as crucial to achieving private sector growth and aims to produce competitive and productive human resources to build the private sector. The government aims to support private sector growth in Botswana by establishing six key hubs (the Transport Hub, the Education Hub, the Innovation Hub, the Medical Hub, the Agricultural Hub and the Diamond Hub (see Box 2.2)). This hub strategy was undertaken as an attempt to diversify the economy by deliberately building Botswana's comparative advantage in areas such as diamond mining and processing, innovation, education, health, tourism, transport and to enable the exploration of regional opportunities and markets. The six hubs were started during the National Development Plan 9 (see box 2) but to date their establishment is still being implemented.

**Box 2.2: The six hubs to achieve diversification**

During National Development Plan 9, and currently in National Development 10, the Government has identified areas to focus on for enhanced economic growth and diversification. The following six 'Hubs' were created:

- The ***Education Hub*** seeks to increase the quality and relevance of education at all levels and, thereby, make Botswana more competitive by attracting leading tertiary institutions, scholars, researchers and students into the country.

- The ***Innovation Hub*** is aimed at creating a platform for local and foreign businesses engaged in research and development and knowledge intensive activities (e.g. ICT). It will also establish an incubator for start-up companies and facilitate networking amongst businesses.
- The ***Agricultural Hub*** will encourage participation in farming, mentor farmers on agribusiness skills, and endeavour to commercialize the agricultural sector in an effort to make the industry more sustainable.
- The ***Diamond Hub*** intends to establish a diamond trade centre for rough/polished diamonds and to promote sustainable downstream diamond activities such as polishing and jewellery making.
- The ***Medical Hub*** hopes to identify projects and programmes that will make Botswana a centre of excellence in the provision of healthcare services. It will also privatise certain hospitals in an effort to attract specialists and optimize the quality of the health facilities.
- The ***Transport Hub*** seeks to re-position the country as a regional hub for rail, road and air transport, and to support a competitive transport and logistics industry in Botswana.

Source: African Development Bank (2009)

The government plans to create links between these hubs so that they support and reinforce one another. For example the diamond hub would be supported by the education hub, which would produce skills for the different industries in the diamond hub, whilst the innovation hub would attract business to perform research for the industry and the transport hub would ensure that all the necessary transport infrastructure needed by the industry is in place. It is clear that the government has formulated a very coherent economic development policy for the country. However, the efficacy of the development policy in creating a diamond hub and all the other hubs will be determined by its implementation (policy implementation will be discussed in more detail in Chapter 10).

The next section provides the global context of Botswana's diamond industry by describing the global diamond value chain, before the last section describes the steps that

were taken by DeBeers and the government to implement the agreements that led to the creation of Botswana's diamond cutting and polishing industry.

### **2.3. Global Context: The Global Diamond Value Chain**

The diamond industry's global value chain is commonly known as the diamond pipeline (Even-Zohar, 2007). As was explained in the previous section, the value chain begins with exploration, which only results in mining if an economically viable diamond resource is found. Once diamonds have been mined they are sorted (and valued) to separate industrial diamonds from gemstone diamonds. Industrial diamonds are used in industrial equipment including drilling, cutting, grinding, polishing and other industrial applications. This research focuses on the value chain for gemstone diamonds given the greater potential for value-added in gemstone diamonds and they are the focus of the Botswana government's beneficiation strategy. Gemstone diamonds represent about 55 per cent<sup>9</sup> of global diamond production (US Geological Services data). Gemstone diamonds are distributed to experts to cut and polish in preparation for jewellery manufacturing. Polished diamonds are then set into jewellery and diamond jewellery is sold to the final consumer through the global retail industry.

The value of a diamond increases significantly as it moves up the value chain, see Table 2.6. If the producer's selling value is taken as 100, by time the same diamond has been sorted, valued, cut and polished, traded and manufactured into jewellery its value in the retail market is more than three times the producer's selling value. The biggest value added margins are in the retail segment and the smallest margins are in the cutting and polishing segment of the value chain. However, the cutting and polishing segment is the most labour intensive stage and thus has the greatest potential for job creation.

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<sup>9</sup> The dividing line between gem qualities and industrial uses has become rather arbitrary. Industry expert Chaim Even-Zohar believes that that 65% of the world's output measured in carats is cuttable today and therefore should not be viewed as industrial types (2007:171). The US Geological Survey sees it differently, and considers 45% of world output still as industrial.

**Table 2.6: Value addition in the diamond pipeline**

<i>Stage of Global Value Chain</i>	<b>Percentage of Original Value</b>
Producer Selling Value	100
Sorting and Valuing	115
Cutting and Polishing	127
Polished Dealing	133
Jewellery Manufacturing	166
<b>Retail</b>	320

Source: Even-Zohar (2007)

The next section identifies industry's major players in production and manufacturing.

### *Producers*

The diamond production figures presented here are compiled from the Kimberley Process data based on the Kimberley Process Certification Scheme (KPSC). The KPSC was established in 2003 and certifies diamond rough exports and imports in over 70 member countries to confirm that these diamonds are from conflict-free sources. The Kimberley Process (KP) is the principal international effort to sever the link between conflicts and diamonds while ensuring that no harm is done to the legitimate diamond industry (Even-Zohar, 2007:912) by assuring consumers that they are not buying diamonds that are funding wars and human rights abuses. The KP system has not been without criticism, most recently for its certification of diamonds coming from Zimbabwe (see Partnership Africa Canada, 2012), discussed later in this section.

In 2008, global diamond production was close to 163 million carats<sup>10</sup> worth about US\$12.7 billion. Global production fell in 2009 as many producers suspended production as a result of the financial crisis that started in the fourth quarter of 2008, which resulted in a major fall in demand in the diamond value chain. Botswana is the largest producer of gemstone

<sup>10</sup> A carat is a unit used to measure gemstones, equal to 200 milligrams (0.2 g)

diamonds by value, producing over 32 million carats of diamonds in 2008 worth about US\$3.3 billion, which represented about a quarter of global production. Botswana is followed by Russia and Canada, which produced 19.7 per cent and 17 per cent of production respectively in 2008. Unlike Botswana, in 2009 Russia did not reduce production during the recession, the Russian government chose to stockpile production (Prinsloo, Spektorov and Linde, 2011:42).

**Table 2.7: Producers of gemstone diamonds by value (US\$, current)**

<i>Country</i>	<i>2007</i>		<i>2008</i>		<i>2009</i>	
	<i>US\$</i>	<i>Share</i>	<i>US\$</i>	<i>Share</i>	<i>US\$</i>	<i>Share</i>
Botswana	2,960,144,000	24.45%	3,273,001,000	25.71%	1,456,454,000	16.86%
Russia	2,625,100,500	21.68%	2,508,957,130	19.71%	2,340,640,600	27.10%
Canada	2,657,014,734	21.95%	2,254,710,606	17.71%	1,474,944,768	17.08%
South Africa	1,417,331,400	11.71%	1,236,240,109	9.71%	855,544,181	9.91%
Angola	1,271,955,353	10.51%	1,209,789,970	9.50%	1,179,209,718	13.65%
Namibia	715,434,111	5.91%	918,033,931	7.21%	408,741,127	4.73%
Australia	364,629,604	3.01%	326,394,285	2.56%	312,708,458	3.62%
DRC	364,783,294	3.01%	431,833,163	3.39%	225,839,908	2.62%
Lesotho	2,657,542	0.02%	222,680,825	1.75%	133,639,202	1.55%
Sierra Leone	141,565,685	1.17%	98,772,171	0.78%	78,423,595	0.91%
Guyana	34,399,461	0.28%	53,698,456	0.42%	14,557,427	0.17%
CAR	59,857,871	0.49%	47,752,282	0.38%	47,086,830	0.55%
Zimbabwe	31,400,904	0.26%	43,825,425	0.34%	20,426,782	0.24%
India	4,691,285	0.04%	31,190,623	0.24%	1,663,091	0.02%
Tanzania	28,315,099	0.23%	24,083,955	0.19%	24,781,885	0.29%
Guinea	46,101,145	0.38%	18,460,766	0.14%	28,975,789	0.34%
Liberia	-	-	9,891,785	0.08%	11,260,573	0.13%
Indonesia	328,146,969	2.71%	7,899,876	0.06%	819,081	0.01%
Brazil	25,807,516	0.21%	6,221,579	0.05%	830,115	0.01%
Ghana	23,202,422	0.19%	5,250,000	0.04%	6,984,025	0.08%
China	1,110,000	0.01%	1,370,000	0.01%	480,000	0.01%
Togo	1,709,644	0.01%	927,757	0.01%	15,025	0.00%
Venezuela	1,192,285	0.01%	1,293,116	0.01%	-	-
Congo	-	-	-	-	2,190,000	0.03%
<b>Total</b>	<b>12,106,550,822</b>		<b>12,732,278,808</b>		<b>8,636,216,180</b>	

Source: Kimberley Process Database

Apart from Australia and Guyana which were respectively the 7<sup>th</sup> and 11<sup>th</sup> largest producers in 2008, the next 10 producers were all African countries South Africa, Angola, Namibia, Democratic Republic of Congo (DRC), Lesotho, Sierra Leone, Central African Republic and Zimbabwe. The export figures reported by the Kimberley Process probably underestimate the actual amount of exports coming from some African producers, such as DRC, Sierra Leone and Angola which are well known for smuggling and/or underreporting their diamond exports (Even-Zohar, 2007:69).

Furthermore, Zimbabwe's diamond exports are very contentious due to suspected human right abuses by the ruling party, the Zimbabwe African National Union – Patriotic Front (ZANU-PF). Activists say the army killed over 200 artisanal miners in the diamond field when the Government took control of the field (BBC, 2<sup>nd</sup> November 2009) and the country was put under economic sanctions by the United States (US) in 2003 due to its undemocratic government. Zimbabwe diamond exports were suspended from the Kimberley Process in November 2009 but limited exports were allowed in July 2010 (BBC, 16<sup>th</sup> August 2010). The members of the Kimberley Process have since decided to allow exports from Zimbabwe and they could cause serious reputational problems for the entire industry. Zimbabwe exports could have significant impact on diamond supply as the country is expected to have large diamonds reserves that may see it produce US\$1.7 billion worth of diamonds per year becoming one of the top 6 producers in the industry (BBC, 16<sup>th</sup> August 2010). Global diamond production is expected to decrease in the next couple of decades due to the depletion of the known reserves as, apart from Zimbabwe, no major new reserves have been found to replace the diminishing reserves. Rough diamond supply is currently less than demand (increasing prices for rough diamonds) and this gap is expected to keep widening if no new major reserves are found (Wyndham, 2009).

## Manufacturers

The presence of countries in manufacturing or processing diamonds is not necessarily related to having a presence in the mining of rough diamonds. This is because diamonds are often not processed where they are sourced. Historically, the major diamond polishing centres were in Belgium, Israel and the USA but the industry has since migrated to Asia, particularly India and China, as a result of relatively lower wages. Today the major diamond polishing centre is in India. India's share and the share of other centres in global manufacturing is shown in Table 2.8. The principle Asian centres (India and China) mainly manufacture smaller diamonds whilst the traditional centres (Israel, Belgium and the USA) generally manufacture bigger diamonds (Even-Zohar, 2007).

**Table 2.8: Manufactures of polished diamonds<sup>11</sup> (US\$, current)**

<i>Country</i>	<i>2006</i>		<i>2007</i>		<i>2008</i>	
	<i>US\$ Billion</i>	<i>Share</i>	<i>US\$ Billion</i>	<i>Share</i>	<i>US\$ Billion</i>	<i>Share</i>
India	10.84	58%	11.59	58%	11.6	59%
Thailand, China & Others <sup>12</sup>	2.5	13%	2.86	14%	2.86	15%
Israel	2.58	14%	2.41	12%	2.1	11%
Russia	1.2	6%	1.1	6%	0.95	5%
South Africa	0.8	4%	0.9	5%	0.91	5%
USA	0.3	2%	0.4	2%	0.75	4%
Belgium	0.4	2%	0.6	3%	0.5	3%
Botswana <sup>13</sup>	-		-		0.1	1%
<b>Total</b>	<b>18.72</b>		<b>19.86</b>		<b>19.7</b>	

Source: Tacy Ltd (excluding Botswana's data)

In 2008, the global diamond cutting and polishing industry manufactured US\$19.7 billion worth of polished diamonds. India, the world's biggest diamond cutting and polishing centre manufactured almost 60 per cent of the polished diamonds worth US\$11.6 billion in 2008. China and other producers in Asia (like Thailand) together are the second largest

<sup>11</sup> At polished wholesale prices (pwp).

<sup>12</sup> The manufacture of polished diamonds in these countries were reported together.

<sup>13</sup> Botswana share is a DeBeers estimate and manufacturing for 2008 from Botswana's Diamond Hub.



manufactures of diamonds, manufacturing close to 15 per cent of polished diamonds worth US\$2.86 billion in 2008. Unlike Belgium, Israel still has a significant share in global manufacturing, making it the third largest manufacturer of polished diamonds, manufacturing close to 11 per cent of global polished diamonds worth US\$2.1 billion in 2008. Russia and South Africa, which are also major diamond producers, are the fourth and fifth largest manufacturers of polished diamonds manufacturing 4.8 and 4.6 per cent share of polished diamonds worth US\$0.95 billion and US\$0.91 billion respectively. The traditional centres, the USA and Belgium are the sixth and seventh largest manufacturers of polished diamonds, manufacturing 3.8 and 2.5 per cent respectively in 2008. According to the Botswana government, the country's relatively new centre only manufactured 1 per cent of polished diamonds in the same year. Thus, 3 years after the agreement between DeBeers and Botswana government was signed, Botswana was still a relatively small player in the manufacturing segment of the diamond value chain.

The countries that are significant diamond manufacturers have highly developed cutting and polishing craft skills that have been acquired over time. For example, the Belgium cutting and polishing industry can be traced back to 1515 and Israel's to the 1930s. Both countries have developed the skills and knowledge needed to manufacturer larger, higher value diamonds. Over time the manufacture of lower valued, smaller diamonds has shifted to low cost countries like India and China, which established cutting and polishing industries in 1967 and 1985, respectively, have developed the relatively lower skills needed to manufacture smaller, lower value diamonds. However, over time India and China are developing the capabilities to process bigger diamonds as well. Today the two countries employ 98 per cent of the world's diamond manufacturing workforce (Even-Zohar, 2007:593).

DeBeers is a major player in the diamond value chain that Botswana participates in, determining prices and the participants in the downstream value chain. Thus the next section discusses role of DeBeers in the value chain.

### **2.3.1. The Role of DeBeers in the Diamond Value Chain**

The founding of DeBeers in 1888 and the creation of its single marketing channel in the mid-1930s have had the greatest influence on the modern diamond industry (Sevdermish, Miciak and Levinson, 1998). DeBeers has its main direct ownership in the upstream activities (exploration and mining) of the value chain. It has little direct control on the downstream (cutting and polishing and jewellery manufacturing) part of the value chain. But it has managed to use the distribution of rough diamonds and the marketing of diamonds to control downstream activities in the value chain. Historically, DeBeers was able to control the entire industry from mine to consumer through its dominant position in the upstream industry which, at its peak, saw DeBeers control over 80 per cent of the world's rough diamond supply. This extensive degree of control arose as a direct consequence of limited global supplies of diamonds, and their concentration in a region (Southern Africa) in which DeBeers was a near-monopolistic producer.

DeBeers established the single marketing-channel for diamonds and managed it through the company's Central Selling Organisation (CSO) to stabilize prices and profits in the entire industry. DeBeers stabilised prices by controlling the supply of rough diamonds released into the downstream industry to maintain disequilibrium between supply and demand. To maintain this disequilibrium, DeBeers managed and maintained a buffer stock or stockpile of rough diamonds. DeBeers controlled the release of diamonds into the market by only selling rough diamonds to chosen cutting and polishing companies, known as Sightholders, once a month at selling weeks known as Sights. Thus the distribution of diamonds by the CSO enabled DeBeers to control the type and quantity of diamonds

released into the industry and maintain prices by ensuring supply was less the demand. This enduring near-monopoly is possibly one of the longest-lived selling cartels in the global economy (Sevdermish, Miciak and Levinson, 1998).

Overall the strategy was highly successful because whilst price fluctuations are accepted as normal in most commodities, this was not generally the case for diamonds (Sevdermish, Miciak and Levinson, 1998:73). Apart from maintaining prices, DeBeers appointed itself as the custodian of the entire industry by conducting consumer research, advertising, promotions and publicity for the industry to position diamonds as a premium high-priced product and thus to generate, and in some cases to limit, the demand for diamond jewellery. DeBeers promoted diamond jewellery sales worldwide by means of its highly regarded advertising programmes which resulted in the one the most famous advertising slogans ‘A diamond is forever’.

Since the 1980s, DeBeers’ market power has been decreasing as a result of various factors including the entry of new producers like Rio Tinto, BHP Billition, Lev Leviev and Alrosa due to new discoveries in Australia and Russia and the growth of the diamond cutting industry in India (Sevdermish, Miciak and Levinson, 1998:72). DeBeers did make attempts to bring the new producers into its selling cartel but these attempts were largely unsuccessful. In Russia, there was a series of conflicts between DeBeers and the new producer and an increasing percentage of Russian diamonds are now sold outside the CSO. In Australia, the termination of Argyle diamond mine’s contract with De Beers reduced the latter’s presence in the lower end of the market. These lower quality Argyle diamonds are known as “Indian Goods”<sup>14</sup> and are mainly processed in India where the relatively lower costs ensure that they are still profitable to polish. In Canada, De Beers was able to secure

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<sup>14</sup> These diamonds were previously classified as industrial diamond but are now classified as ‘near gems’.

35 per cent of the production of Ekati and launched a successful takeover of Winspear but does not hold a dominant position in the country (Chang et al, 2002).

As a result of the new independent marketing channels, DeBeers' market share decreased from 80 per cent to about 40 per cent of the industry (Sevdermish, Miciak and Levinson, 1998). Today the industry is no longer a monopoly structure but an oligopoly dominated by a number of major producers. However, even in the new market structure, DeBeers still plays a major role in setting rough diamonds prices for the industry.

Realising that it could no longer control supply, DeBeers announced a major shift from a supply-driven to a demand-driven strategy. DeBeers implemented the Supplier of Choice (SOC) sales strategy in 2003 to facilitate this shift to a demand-driven industry. This sales strategy spells out the new criteria that DeBeers uses to select its Sightholders and part of these criteria are designed to shift advertising and marketing responsibilities from DeBeers to the Sightholders. DeBeers now selects its Sightholders based on the following criteria: financial ability, market position, distribution ability, marketing ability, and manufacturing ability. As part of the supplier of choice contract, the CSO was renamed the Diamond Trading Company (DTC). DTC's headquarters are in London and DTC also operates in South Africa, Canada, Botswana and Namibia as result of pressure on DeBeers from the governments in these diamond producing countries for beneficiation. Internationally there are 73 DTC licensed Sightholders, this number is down from well over 100 Sightholders before SOC. The DTC Sightholder status is highly valued by the manufacturers because it assures the company of a long-term supply of rough diamonds and DTC diamond assortments represent good value relative to other mining sources (Even-Zohar, 2007).

The SOC's biggest impact has been on the Sightholders' business strategies. The main characteristics that Sightholders had to possess before the SOC were manufacturing and

financial ability but with the addition of the new criteria Sightholders are encouraged to drive consumer demand by creating high value-added brands and increasing marketing and advertising. This has resulted in a shift towards vertical integration, where Sightholders are involved in a number of different activities in the downstream industry other than diamond cutting and polishing activities. The Sightholders have embarked on joint ventures or complete acquisitions of jewellery manufacturing and retail companies in order to meet the SOC criteria. At the other end of the value chain, retailers have also shifted towards vertical integration in order to secure diamond supplies, which are expected to decrease in the future if no major new discoveries are made. For example, the major diamond jewellery retailer Tiffany now owns diamond mines and cutting and polishing factories. Thus the entire downstream industry has shifted towards vertical integration. Despite this shift, DeBeers still determines the type, quantity and prices of rough stones that are available to the cutting and polishing factories that source diamonds from the DeBeers' distribution channel.

## **2.4. The Development of Botswana's Downstream Diamond Industry**

In 2005, after the agreement between the DeBeers and the Botswana government was signed, DTC Botswana was established. DTC Botswana, like Debswana, is a 50 per cent joint partnership between the government and DeBeers. Firstly, DTC Botswana is responsible for sorting and valuing all of Debswana's production. Previously all diamonds mined by Debswana were sorted and valued by the Botswana Diamond Valuation Company (BDVC). The BDVC was started in 1974 and previous to its establishment all Debswana output was sorted in London by DTC international. Secondly, as was discussed in Section 2.1.2, in line with the government's beneficiation strategy, DTB Botswana is also responsible for making rough diamonds available for local manufacturing:

“In addition DTC Botswana will carry out the local sales and marketing activities, working closely with its customers to support the establishment of diamond manufacturing operations in Botswana” (Even-Zohar, 2007:257).

DTC Botswana is responsible for supplying the Sightholders with rough diamond supply and employment of at least US\$500 million worth of rough diamonds and 3000 workers a year and growing. It is not clear how the Government reached these numbers. The agreement does not stipulate the timescale in which these sales and employment targets should be reached. There is a penalty clause for non-performance in the area of beneficiation for DeBeers, so DeBeers has a vested (and financial) interest in making beneficiation a success in marked contrast to the past (Even-Zohar, 2007:235).

After DTC Botswana was established DeBeers helped bring some of its clients, Sightholders, to Botswana. As discussed in the previous section, Sightholders have, amongst other capabilities, the technical expertise to cut and polish certain types (cut, quality, sizes) of diamonds. The Sightholders licensed in Botswana were given licenses on condition that they train locals with cutting and polishing skills. In exchange for their technical expertise, the cutting and polishing firms would receive the types of diamonds and quantities of diamonds that would enable them to operate successful factories in Botswana. DTC Botswana allocates rough diamonds to the companies through a “competitive allocation system designed to promote skills transfer and sustainable local beneficiation” (DTCB, 2012). The supply of rough diamonds to the Sightholders is determined by the DTC’s Beneficiation Criteria:

“All DTC Sightholders are offered the rough diamonds at the same price. However, the application of Sightholders with operations in Botswana, for supply and on-going performance throughout a contract period is assessed against

criteria, which include a series of ‘beneficiation criteria’” (Lynette Gould, Diamond World News Service, 22<sup>nd</sup> October 2012).

These ‘beneficiation criteria’ aim to monitor skills transfer, through collecting employment data. The Sightholders want the rough diamond supply, especially in light of falling global supply of rough diamond, and to get this supply they have to create employment and transfer skills to locals. Table 2.9 shows the various company details for the 21 companies that have been licensed by DTC Botswana.

**Table 2.9: Botswana’s 21 Sightholders/cutting and polishing firms**

<i>Sightholder</i>	<i>Est.</i>	<i>Origin</i>	<i>Downstream Value Chain Activities</i>
Blue Star	2011	India	Cutting and polishing, jewellery manufacturing
Dalumi	2007	Israel	Cutting and polishing, jewellery manufacturing, retail
Diamond Manufactures Botswana	1982	Belgium	Cutting and polishing
DDM ARABOV	2007	Israel	Cutting and polishing, jewellery manufacturing, retail
Chowtai Fook	2011	China	Cutting and polishing, jewellery manufacturing, retail
Eurostar	2004	Belgium	Cutting and polishing
Hearts and Arrows Cutting Works	2007	Belgium	Cutting and polishing, jewellery manufacturing
Julius Klein Group	2007	USA	Cutting and polishing, jewellery manufacturing
Laurelton Diamonds	2007	Belgium	Cutting and polishing, jewellery manufacturing, retail
Lazare Kaplan Botswana	2007	USA	Cutting and polishing, jewellery manufacturing, retail
Leo Schatcher Botswana	1990	Israel	Cutting and polishing, jewellery manufacturing
Motiganz	2007	Israel	Cutting and polishing, jewellery manufacturing
Pluckzenic Botswana	2007	Belgium	Cutting and polishing, jewellery manufacturing, retail
Shrenuj	2007	India	Cutting and polishing, jewellery manufacturing, retail
South African Diamond Company	2007	South Africa	Cutting and polishing, jewellery manufacturing, retail
Steinmetz	2007	Israel	Cutting and polishing, jewellery manufacturing, retail
Suashish	2007	India	Cutting and polishing, jewellery manufacturing,

			retail
Taché	2011	Belgium	Cutting and polishing, jewellery manufacturing
Teemane Diamond Manufacturing	1980s	Belgium	Cutting and polishing, jewellery manufacturing, retail
Zebra Diamonds Botswana	2007	Belgium	Cutting and polishing, jewellery manufacturing
Yerushalmi	2007	Israel	Cutting and polishing, jewellery manufacturing

Source: DTC Sightholders List

The government selected some of the Sightholders, whilst some were recommended by DeBeers. The government chose firms with different business models in order to understand what type of firm strategy would work in Botswana. For example Eurostar Botswana has a more labour intensive manufacturing strategy, manufacturing smaller diamonds that require lower costs but use more workers, whilst Suashish Diamonds uses a more capital intensive manufacturing strategy which makes use of more technology and less workers (Interview, Gaborone, June 2009). According to the Diamond Trading Company's (DTC) Sightholder directory, the diamond cutting and polishing firms operating in Botswana are amongst leading diamantaires in the world and these companies "...were carefully chosen for their ability to add value to diamonds in Botswana, their expertise in particular rough diamonds and their financial and ethical integrity" (DeBeers, 2007). So along with their marketing, distribution and financial capabilities, these firms have highly developed technical expertise that allow them to earn in profits in the manufacturing of particular types of diamonds.

After the 2005 agreement, 16 Sightholders were licensed in Botswana by DTC Botswana and in 2011 five more Sightholders were licensed by DTC Botswana. There are now 21 Sightholders licensed in Botswana and all these diamond cutting and polishing firms are foreign owned, with only two of the 16 Sightholders licensed after the 2005 agreement having local shareholders. The local shareholders generally have no technical expertise and invested capital in the companies to become shareholders. The local firms are subsidiaries



of foreign companies from established diamond cutting and polishing centres. Their parent companies have a long history in the cutting and polishing industry, with some of their parent companies having been established in the early 1900s. Diamantaire families that have a long involvement in the cutting and polishing industry own the parent companies. For example one of the parent companies, Steinmetz owned by the Steinmetz family from Israel, describes itself as “Creators of the world’s finest diamonds with seven decades of expertise and heritage...”<sup>15</sup>.

The skills and knowledge for cutting and polishing diamonds have been passed down within the parent company from one generation to another. So the 21 companies, through their parent companies have highly developed technical capabilities in various categories of diamonds as shown by the production ranges that they have listed under the profiles in DTC Sightholder directory. The parent companies are also vertically integrated and participate in other parts of the value chain such as jewellery manufacturing and/or retail. At the end of 2011, two of the Indian firms operating in Botswana, Shrenuj and Suashish, had started jewellery-manufacturing operations in Botswana.

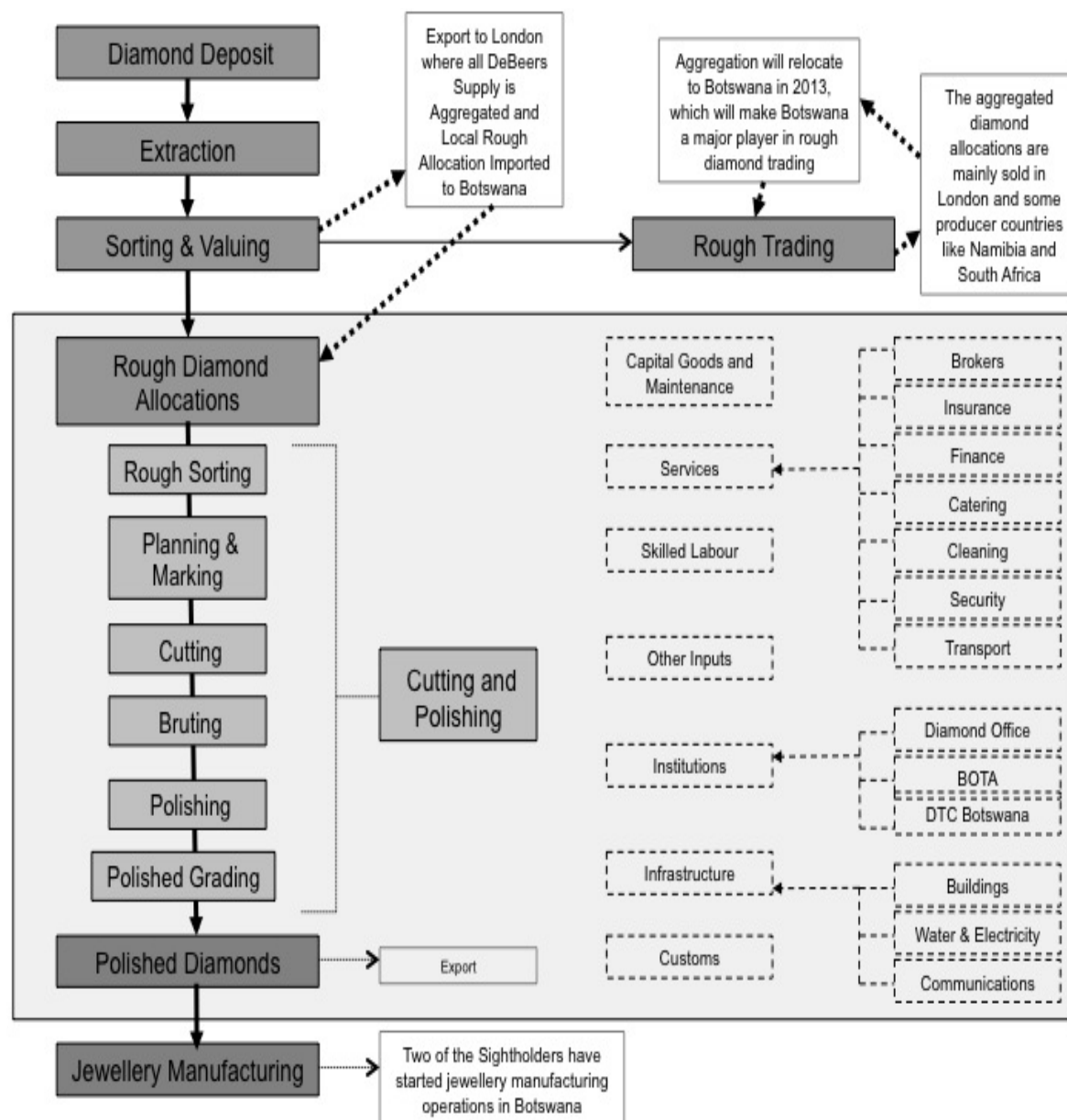
Figure 2.5 maps the Botswana’s diamond cutting and polishing value chain. The items on the left hand side of the diagram are the various production stages required to turn a rough diamond into a polished diamond. These production stages are discussed in more detail in Chapter 5. The items on the right hand side of the diagram show all the various inputs (goods and services) required by the cutting and polishing industry. Although Botswana’s 21 cutting and polishing firms are regularly supplied with rough diamonds by DTC Botswana, these firms are also able to buy diamonds from other sources. Once Debswana’s production is sorted and valued by the DTC Botswana, it is exported to London. Prior to the beneficiation policy, Botswana diamond value chain ended here. In London, DeBeers

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<sup>15</sup> <http://www.steinmetzdiamonds.com/en/>

aggregates all of its supply, which includes diamonds mined by DeBeers in South Africa, Namibia, Canada, Botswana and those bought by the company in the open market.

**Figure 2.5: Botswana's diamond value chain**



Source: Compiled based on the author's fieldwork research

These are mixed together into what is known as the 'London mix' and these aggregated diamond parcels are sold to Sightholders, ten times a year during sales weeks known as Sights (Even-Zohar, 2007). Once diamonds have been aggregated in London, Botswana's allocation of rough diamonds is exported to Botswana and is sold to the 21 cutting and

polishing firms, known as Sightholders, by DTC Botswana. So, each local Sightholders' aggregated parcels of rough diamonds are prepared in London and sent to Botswana to be sold and marketed locally. Thus the diamonds sold in Botswana for local processing are not necessarily mined in Botswana but are a mixture of all DeBeers' supply.

DeBeers agreed to relocate the aggregation process to Botswana as part of its 2005 agreement with the Government. But five years after the agreement was made, DeBeers had still not relocated the aggregation process to Botswana. At the end of 2011, a year after the marketing agreement had ended, DeBeers and the government finally negotiated a new set of marketing agreements. The signing of the new agreement has been equated to Botswana's "Diamond Independence Day" because it gave the government more control over the future of the country's diamond industry (Even-Zohar, 2011).

The new agreement is for 10 years instead of 5 years. It also stipulates that not all of Botswana's production would be sold to DTC. Instead 10 per cent of Botswana's production will be made available for the government to sell independently through its own marketing window. Furthermore, the government and DeBeers agreed that the 10 per cent made available to the independent marketing window would increase to 20 per cent by the end of the agreement. This window will give Botswana an opportunity to determine how the prices used by DTC compare to market prices. "Traditionally, a window, i.e. a set percentage of the run-of-mine production, allows a producer government to check on the actual prices for which the DTC sell a given product" (Even-Zohar, 2011:6648). The government has started the Okavango Diamond Company, which will be responsible for selling diamonds for the government from the second quarter of 2013. The new agreement also renewed the previously agreed relocation of aggregation activities to Botswana. DeBeers is currently in the process of relocating aggregation to Botswana, which the company expects to be completed by the end 2013.

The Sightholders have to be well financed because rough diamonds are expensive and DTC only accepts US dollar denominated cash. According to a DTC Botswana official local rough sales were US\$367 million per annum in 2009 and DTC Botswana required that 70 per cent of these sales be processed locally (Interview, Gaborone, 28<sup>th</sup> October 2009). Most of the Sightholders use a broker to facilitate the purchase of diamonds at the DTC Botswana Sight weeks. The brokers also provide the Sightholders with other business services to ensure that they comply with the DTC Botswana.

Once the rough diamonds parcels have been sold to the manufacturers, it takes them three to four months to process the rough diamond parcel into polished diamonds. Diamonds are cut and polished using a series of steps (discussed in more detail in Chapter 5) to prepare them for jewellery manufacturing. During the production of polished diamonds the factories require human resource inputs, service inputs, utility inputs and capital goods and maintenance (see Figure 2.5). When the 16 firms were established in Botswana there was no readily available pool of labour with diamond cutting and polishing skills and the firms are responsible for transferring these skills to locals. In the years that followed the agreements with DeBeers, Botswana has made progress in establishing a local cutting and polishing industry. The Government has established a Diamond Office to support the government's primary objective of beneficiation in Botswana's diamond industry. This office focuses on building strategic alliances, developing infrastructure and enabling a favourable fiscal regime in order to support diversification in the diamond industry and has managed to attract global companies that service the diamond industry in other cutting and polishing centres around the world to set up offices in Botswana. The diamond office is located at the Diamond Technology Park, which houses various ancillary businesses including banking, logistics, gemmology, security and brokering companies.

## **2.5. Conclusion**

For the last four decades Botswana, the world's largest producer of diamonds by value, has enjoyed resource rents arising from its large endowment of diamond resources that have underwritten the country's growth. The revenues that Botswana earns from diamonds are expected to decrease significantly in the next two decades if no new large discoveries are made. The Government has used the power generated by the country's diamond endowment to deepen value added through forward linkages. As a result of government-will rather than market forces, 21 cutting and polishing factories are operating in Botswana.

The government's intention is that the country creates diamond cutting and polishing capabilities that can continue to benefit the country when diamond mining ceases to be profitable. However, creating cutting and polishing skills appears to be a difficult task since large accumulations of skills created over a long period of time explain why countries like Israel, Belgium and India have competences in different segments of the industry. Since large accumulations of human capital explain the dominance of major players in the diamond cutting and polishing industry, then the most crucial part of the Government's plan is to successfully develop the downstream competencies needed to process diamonds. The success of Botswana's diamond cutting and polishing industry hinges on the development of the necessary capabilities, skills and knowledge.

The next chapter will discuss the research questions that can provide insight in to how Botswana can upgrade its diamond value chain by successfully building downstream capabilities in the diamond cutting and polishing industry.

## **Chapter 3**

### **Research Questions and Methodology**

#### **3. Introduction**

In line with the Botswana government's vision to capture more value added in the diamond value chain by becoming a downstream player, this thesis aims to investigate how Botswana can efficiently build the crucial skills and knowledge needed in the diamond cutting and polishing industry. As was explained in Chapter 2, the success of Botswana's cutting and polishing industry hinges on the successful development of the human resources required by the industry. This section discusses the overarching and specific research questions and the methodology used to address these research questions.

#### **3.1. Research Questions**

The overarching research question in this research is as follows: in order to foster diversification in Botswana's diamond industry through the downstream processing of diamonds, how efficiently is the necessary human capital being developed through training in diamond cutting and polishing industry? The specific research questions used as guidance to answer the overarching research question are as follows:

1. What is the theoretical understanding of human capital formation through training, in the firm, in industry level training institutes and in the wider education and vocational training system?
2. What are the skills and knowledge required by the diamond cutting and polishing industry?
3. How is human capital formation taking place in Botswana's diamond cutting and polishing industry?

4. How does training in Botswana's nascent diamond cutting and polishing industry compare with training in a developed diamond processing centre?
5. How does training in Botswana's diamond cutting and polishing industry relate to the theoretical understanding of training?
6. With reference to how technology has changed skills requirements in other traditional craft industries, will the increasing role of technology in the diamond cutting and polishing manufacturing processes impact on the human capital and therefore training required by the firms?

### **3.2. Methodology**

This section provides a description of how the research was conducted in order to address the research questions. The principle methodology used to address the research questions involved primary and secondary data analysis. This section includes a description of the secondary data sources, as well as a description of how and with whom the primary data was collected.

#### *Literature Review*

The value chain literature was reviewed with regard to upgrading and the concept of rents as these concepts are important in understanding how Botswana was able to force the forward linkages and how cutting and polishing skills are important in making the country and firms competitive. Human capital theory is explored in order to build a theoretical understanding on how the development of human capital should take place in a country. This will shed light on the journey Botswana has to take to build competences in its nascent cutting and polishing industry. The literature on the impact of technological change on craft skills in other manufacturing industries was also reviewed in order to understand how the increased use of technology might impact on training in the cutting and polishing industry. The findings for the literature review are discussed in Chapter 4.

### *Secondary Data Analysis*

Secondary data analysis is crucial to Chapters 5, 6 and 9. Chapter 5 identifies the human capital requirements of the cutting and polishing industry. This chapter makes use of secondary material written on the process of cutting and polishing diamonds, particularly training manuals published by the Canadian government. Chapter 6 provides an overview of the role of Botswana's education and vocational training system in meeting the human capital requirements of the firms. This chapter makes use of secondary material on Botswana's education system, particularly empirical data published by the United Nations Education, Scientific and Cultural Organisation (UNESCO), Botswana's Central Statistics Office, the Ministry of Education and Skills Development and the Ministry of Labour and Home Affairs. Chapter 9 provides an overall assessment of the research findings on human capital formation in Botswana's cutting and polishing industry. It also describes the technological changes that have and are taking place in the cutting and polishing industry and how they will impact on the industry's training requirements. The chapter makes use of articles from journals, particularly the *Gems and Gemmology* journal, which describe the technological changes taking place globally in the cutting and polishing industry.

### *Primary Data Analysis*

Primary data analysis informs all the analytical chapters but it is especially important in Chapters 7 and 8, which discuss the role of training institutes and firms in training workers with the skills and knowledge required by the industry. Desktop background research was conducted to identify the key participants in Botswana's diamond cutting and polishing industry. Pilot fieldwork was then conducted in June 2009 to understand the development of the industry and the key constraints it faces. Further fieldwork was conducted in October and November 2009 and again from February to May 2010. Interviews were conducted with key participants in the cutting and polishing industry (see Table 3.1), suppliers (see Table 3.2), government, private sector and academia (see Table 3.3).



Interviews were conducted in English and Setswana using a semi-structured questionnaire and lasted from 30mins to 2 hours. The data collected was of both a quantitative and qualitative nature. Some respondents were interviewed more than once and in some instances whole days were spent in the factories where I learnt about the different production processes by observing and interviewing various types of workers.

**Table 3.1: Respondents in the cutting and polishing factories**

<i>Population (16)</i>	<i>Origin</i>	<i>Interviewed (12)</i>
Motiganz Botswana	Israel	Yes
Suashish Diamonds Botswana	India	Yes
Lazare Kaplan Botswana	Israel	Yes
Leo Schachter Botswana	Israel	Yes
Diamond Manufacturing Botswana	Belgium	Yes
Eurostar Botswana	Belgium	Yes
SAFDICO Botswana	South Africa	Yes
Steinmetz Diamonds Botswana	Israel	Yes
Zebra Diamonds	Belgium	Yes
H&A Botswana	Thailand	Yes
Teemane Manufacturing Botswana	Belgium	Yes
Sherenuj Botswana	India	Yes
Laurelton Diamonds Botswana	South Africa	No
Pluckzenic Botswana	Belgium	No
Dalumi	Israel	No
Yerushalmi	Israel	No

Twelve cutting and polishing firms were interviewed out of an overall population of 16 that were operating in Botswana at the time. The population has since increased to 21 firms as a result of the latest agreement with DeBeers and the Government of Botswana, as was discussed in Chapter 2. Prior to fieldwork the aim was to interview all the firms in the industry but this was not possible as some firms did not agree to be interviewed and others

were not available to be interviewed during the fieldwork period. The sample represents 62.5 per cent of the population at the time. Since the firms were not willing to discuss their production levels it is not clear what share of the market the interviewed firms represent. However, the sample is representative in terms of nationality of ownership, firm-size (based on employment) and the number of years established in Botswana. These and other firm characteristics in the sample will be discussed in greater detail in Chapter 8.

The 12 factories that were interviewed accounted for close to 80 per cent of the industry's total employment. The sizes of the firms ranged from as small as about 60 employees to as large as close to 500 employees. The average employment in the firms was 207 workers. The biggest of the interviewed firms represented 15 per cent of the industry's total employment.

Six firms were interviewed that participate in the cutting and polishing industry's supply chain. These firms mainly provide services to the cutting and polishing firms. The sample is biased towards knowledge intensive services and not all business activities have been covered. Although all business activities are important, knowledge intensive services have the greatest potential for the transfer high-value skills.

**Table 3.2: Respondents in the supply chain**

<i>Business Activities</i>	<i>Population</i>	<i>Interviewed</i>
Transport/Logistics	2	1
Brokers	3	1
Banking	3	1
Gem Certification	1	1
Insurance	2	2
Catering	Unknown	0
Security	Unknown	0

Cleaning	Unknown	0
Specialised Inputs	Unknown	0

A number of institutions in the public sector, private sector and academia were interviewed. The aim of these interviews was to understand the support that the various institutions provide to the cutting and polishing industry with regards to training. These interviews also explored how this support has evolved over time and the current plans to enhance the institutional support provided to the cutting and polishing industry.

**Table 3.3: Government, private sector and academia respondents**

<i>Organisation</i>	<i>Sector</i>	<i>Person(s) Interviewed</i>
Diamond Hub	Government Office	Hub Coordinator Business Development Manager
Diamond Office	Government Office	Diamond Officers
Diamond Trading Company Botswana (DTCB)	Public-Private Joint Venture	Public Relation Manager
Botswana Export Development & Investment Authority (BEDIA)	Parastatal	Director: Business Development
International Financial Services Centre (IFSC)	Parastatal	Business Development Executive
Citizen Entrepreneurship Development Agency (CEDA)	Parastatal	Director: Structured Finance
Local Enterprise Authority (LEA)	Parastatal	Director: SMME Environment
Botswana Institute for Policy Analysis (BIDPA)	Parastatal	Executive Director
Innovation Hub	Parastatal	Principal Project Officer
Department of Minerals	Government Department	Minerals Officer
Grant Thornton	Private	Partner in firm
University of Botswana	Academia	Professor in Economics
Econsult	Private	Managing Director
Consultancy A	Private	Consultants with many years in the diamond industry
Consultancy B	Private	"
Consultancy C	Private	"

Fieldwork was also conducted in the India, Israel and the UK. In Israel, fieldwork took place in February 2011 and interviews were conducted in Tel Aviv and Caesarea with two Sightholders who have factories in Botswana. In India, fieldwork took place in Mumbai and Surat in May 2011, during which three Sightholders were interviewed, one of whom also had a factory in Botswana. In these countries the aim was to understand not only how their parent companies operate in the home countries but also understand how the developed downstream industries in these countries operate. Interviews were also conducted with relevant respondents in charge of regulation, research, training and technology development. In India, respondents in the India Gemmological Institute and India Diamond Institute were interviewed. In Israel, respondents in the Israel Diamond Institute and the Israel Diamond Technology Centre were interviewed. In London, interviews were conducted with senior officials within the DeBeers Group of Companies, as well as with service providers, particularly brokers based in London.

All interviewees received information about the author and the research prior to the interview. After the interviews each respondent was sent a thank you email and when necessary provide further information to address points requiring clarification. Before each interview the respondents were informed that the information they would provide would be presented in an anonymous way. All data from the interviews was transferred from interview notes to electronic form during fieldwork. The data was later merged and coded. Quantitative data was extracted and then analysed using Excel. The names of the interviewees and diamond cutting and polishing firms have been anonymised in the rest of the chapters.

## **Chapter 4**

# **Human Capital: Rents, Formation and the Impact of Technological Change**

### **4. Introduction**

This literature review aims to use human capital theory to build a theoretical understanding of how the development of human capital should take place in the economy. This will shed light on the journey Botswana has to take to build competences in its nascent cutting and polishing industry. The discussion considers the theoretical classification of skills and how skills can be developed by workers, the government, firms, or through industry training institutions. The chapter starts with an explanation of the concept of rents in value chain literature as it is important in explaining how Botswana had the power to force forward linkages and how human resource rents are important in making both the country and firms competitive. Since the cutting and polishing industry is traditionally a craft industry, it is important to understand how technological change has impacted on craft skills in other manufacturing industries. This understanding will help to inform current and future training requirements in Botswana's cutting and polishing firms.

### **4.1. Value Chain Upgrading and Rents**

Global Value Chain (GVC) literature uses value chain analysis to trace the different activities (value added activities) that are required to take a product from conception to the final consumer and finally to disposal. Value chain analysis traces the different economic actors along the value chain and how rent is accrued by these actors. Rents are the economic value earned when economic actors have control of over certain resources, which are subject to barriers to entry that insulate them from competition (Kaplinsky, 2005). These barriers of entry can be God-given, for example, some countries have control

over certain natural resources, or man-made, when say firms have build up certain resources like human resources that enable them to be more competitive then other firms. Value chain literature is concerned with the possibilities for firms to foster dynamic capabilities in the value chain. These dynamic capabilities are the firm's ability to integrate, build, and reconfigure internal and external competences to address a rapidly changing environment (Teece, Pisano and Shuen, 1997). Value chain literature is also concerned with how economic actors can increase the returns earned at different stages of the value chain by moving into, or upgrading to more sustainable and remunerative activities resulting in greater value addition (Kaplinsky and Morris, 2001).

A key concern of GVC analysis is upgrading. Upgrading requires increased sophistication in the management of knowledge. Thus learning mechanisms along the value chain determine whether firms will be successful in upgrading and whether they will stop at process or product upgrading, or will shift to functional or chain upgrading (Bessant *at al.*, 2003). Process upgrading improves the procedures used by the firms to make them more competitive, product upgrading introduces new products that are more competitive, functional upgrading changes the combination of activities done by the firm (for example moving different links in the chain such as from manufacturing to design activities), and chain upgrading is when firms move to a completely different value chain (Kaplinsky and Morris, 2001). Although research gaps exist with regard to minerals-based value chains, some studies conclude that resource-based value chains pose significant challenges in terms of upgrading (Kaplan and Kaplinsky, 1999; Gibbon, 2001). Gibbon (2001) found that international traders often drive value chains of traditional primary commodities and this he argues makes it difficult for producers to identify and take advantage of upgrading opportunities. Kaplan and Kaplinsky (1999) found market distortions in the deciduous fruit canning industry, mainly caused by a combination of protection and subsidies in advanced

countries, that make it difficult for producers in developing countries to take full advantage of the upgrading opportunities presented by this industry.

Value chain analysis stresses the importance of new linkages in capturing optimal local economic development in an industry. In line with this, the Botswana government is pursuing functional upgrading in its diamond value chain by moving away from just extraction activities to create new linkages in more value-added activities in the downstream manufacturing links of the value chain.

The concept of governance is central to the global value chain approach. It contends that some firms in the chain may set and/or enforce the parameters under which other participants in the chain operate (Gereffi, Humphrey and Sturgeon, 2005). Governance has to do with the exercise of power and control in the value chain and impacts on the production process at any point in the value chain. Governance is the inter-firm relationships and institutional mechanisms through which the non-market coordination of activities in the chain is achieved. The main driver of non-market coordination in the diamond value chain that Botswana participates in is DeBeers, which, as was shown in Chapter 2, is a major producer of diamonds through the ownership of mines in various countries like Botswana, South Africa and Namibia. DeBeers determines the parameters of the production of polished diamonds amongst its Sightholders including the price, type and quantity of rough diamond sold to each Sightholder, as well how the final product is marketed.

Botswana has been able to use its supply dominance in the DeBeers Group of Companies to shape a strategy to functionally upgrade its diamond value chain. The conception of upgrading within value chain analysis recognises the existence of rents since it is the relative endowment of resources that determine successful upgrading. Ricardo (1891) was

first to identify rents after noticing that agricultural land was not homogenous because some soil was more fertile than other soils and those with access to the scarce, superior soil derived a rent from it. However, it was Marshall and to a larger extent Schumpeter that developed a framework that helps us understand the process under which rents can be created. Schumpeter developed a concise framework on how rents can be created through the process of innovation, these rents are known as “Schumpeterian rents”. Schumpeter believed that the entrepreneur played a significant role in economic development through ‘the carrying out of new combinations’ (Schumpeter, 1961:107). But overtime these innovations are copied through the process of diffusion that results in “creative destruction” when the entrepreneurial surplus of these innovations are destroyed. Then as entrepreneurs search for a new innovation that is superior to the last one another ‘new combination’ will be created resulting in a new entrepreneurial surplus, which over time like previous innovations will also be destroyed by the process of diffusion. This process is continuous and each time an innovation is diffused it increases productivity in the entire economy, thus spurring economic growth.

There are number of ways that innovating firms can be protected from competition to ensure that competitors find their ‘new combination’ difficult to replicate. Kaplinsky (2005) argues that the source of this protection results in two different categories of rents: (1) rents which are largely under the control of the firm are thus endogenous to the value chain, like technology rents, human resource rents, organisational rents, marketing rents and relational rents, and (2) rents which are created by parties external to value chain like governments, or they could result from a gift of nature and thus exogenous to the value chain, like resource rents, policy rents and infrastructural rents. Table 4.1 shows that an exogenous rent unlike an endogenous rent cannot be classified as Schumpeterian or entrepreneurial rents (Kaplinsky, 2005) (see Table 4.1). But both types of rents are dynamic and cumulative.



**Table 4.1: Summary of the components of rents**

<i>Type of Rent</i>	<i>Endogenous Rents</i>	<i>Exogenous Rents</i>
Schumpeterian Rents	<i>Under control of the firm</i>	
	E.g. Human Resource Rents, Technology Rents, Organisational Rents, Marketing Rents and Relational Rents	
Non-Schumpeterian Rents		<i>Gift of nature or controlled by parties external to the value chain like the government</i>
		E.g. Resource Rents, Policy Rents and Infrastructure Rents

Source: Based on Kaplinsky (2004), table by author

Resource rents explain Botswana's ability to force downstream linkages in its diamond industry. However, over time Botswana's resource rent will decrease as mining becomes less profitable. Therefore, if the country is to upgrade successfully and sustain a diamond-based industry beyond the exhaustion of its diamond deposits, it has to create a new source of rents by developing the countries human resources in a way that would enable competitiveness in downstream diamond-processing activities. According to Gereffi et al (2001: 2):

“The value chain view of global economic integration highlights that for many industries access to international markets is not achieved merely through designing, making and marketing new products. Instead, it involves gaining entry into international design, production and marketing networks consisting of many different firms. Understanding how these value chains operate is very important for developing country firms and policymakers because the way chains are structured has implications for newcomers. How can economic actors gain access to the skills, competences and supporting services required to

participate in global value chains? What potential is there for firms, industries, and societies from the developing world to ‘upgrade’ by actively changing the way they are linked to global value chains?”

A lack of adequate skills in firms, as well as a lack of skills in an economy is a barrier to value chain upgrading (Kaplinsky and Morris, 2001). Skills can block value chain upgrading as a result of factors endogenous to a firm and also as result of the actions of others, in this case the failure of actors in the education and training system. This obstruction to upgrading can only be lifted by availability of the required skills in the economy and in the firms. Therefore it is important to develop a theoretical understanding of how the required skills in Botswana’s cutting and polishing firms should be formed inside the firms and in the wider economy. The availability of the skills required by the diamond cutting and polishing industry will aid the upgrading of Botswana’s diamond value chain.

#### **4.2. The Theoretical Understanding of Human Capital Formation**

This section explores the theoretical understanding of human capital formation in the human capital literature, particularly the role of workers, firms, governments and other institutions in investing in human capital. Human capital theory<sup>16</sup> consists of a body of literature that aims to explain the relationship between education, training and economic growth at the individual, firm and nation level. Human capital has long been identified as a very valuable asset for individuals, firms and countries. In the late 1800s, Alfred Marshall stated in his book *Principles of Economics* that “[t]he most valuable of all capital is that invested in human beings...” (Marshall, 1961: 564). Governments have recognised this and human capital theory has contributed significantly to education and training policies particularly in Western economies since the 1960s after it was widely accepted that large

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<sup>16</sup> See Sweetland (1996) for a comprehensive review of historical development of human capital theory.

differences in national output amongst countries could be largely explained by different levels of investment in human capital (Schultz, 1961).

Adam Smith (1863: 377) defined human capital as:

“... the acquired and useful abilities of all the inhabitants or members of society.

The acquisition of such talents, by the maintenance of the acquirer during his education, study, or apprenticeship, always costs a real expense which is a capital fixed and realised, as it were, in his person... The improved dexterity of a workman may be considered in the same light as a machine or instrument of trade which facilitates and abridges labour, and which, though it costs a certain expense, repays the expense with profit.”

Rosen (2008) defines the acquired and useful abilities of human capital as “... all the productive capacities of human beings as income producing agents in the economy”. These productive capacities are determined by the skills, knowledge, competencies, capabilities and attributes (Healy and Cote, 2001:19) gained by labour through education, experience or training that can be used to produce economic value. According to Schultz (1993) it is helpful to think of human capital as either innate or acquired. The difference being that acquired human capital, unlike innate human capital, is developed through investments in human capital like schooling. Human capital theory views the decision to invest in human capital like any other investment decision that requires one to weigh up the risk and cost of the investment against its expected return.

The human capital literature recognizes different types of human capital investments, which include investments in primary, secondary and tertiary education, and investments through enterprise training or on-the-job training, apprenticeships, as well as vocational

training in the education system either at the secondary or tertiary level. Although Schulz (1961) argues that investments in human capital also include health and nutritional improvements, education and training investments are the primary categories recognised and measured in the human capital literature (Mincer, 1958, 1962, and Schultz, 1971). The returns to the worker from human capital investment include an increase in the worker's productivity and the future income through increased lifetime earnings (Becker, 1964). With regards to the firm, human capital investments improve firm performance as a result of higher worker productivity (see Marimuthu, Arokiasamy and Ismail, 2009).

A fundamental concern of the human capital literature is how these returns are shared between the worker and the firm. According to Leuven (2005:91), "The key distinguishing feature of a human capital investment as opposed to an investment in capital concerns property rights" (Leuven, 2005:91). With human capital investments, the worker has the discretion of how they will deploy their skills and knowledge unlike other investments like machinery and equipment. In other words, "property rights in skills, on the other hand, are automatically vested for a skill cannot be used without the permission of the person possessing it" (Becker, 1975:26). Thus the human capital literature has two key concerns: firstly, the creation of human capital and who should bear the associated cost, and secondly, the use of human capital which raises issues about how the returns to, or benefits from human capital are appropriated. The latter also raises issues around routines or how the skills are used or organised in the firms. This is because appropriation follows from the successful use of skills.

Blair (2011) observes that some have criticised human capital theory for reducing the human experience to a type of commodity. For example, Sen (1997:1960) argues that

human capital theory needs supplementation<sup>17</sup> because “...human beings are not merely means of production (even though they excel in that capacity), but also the end of the exercise”. However, human capital theory does provide a powerful analytical tool for understanding the formation of skills, knowledge and capabilities in a country, industry or firms. In order to construct this analytical tool, this literature review is concerned with understanding how the state, firms, and workers share the costs and benefits of investments in human capital. The next section will examine the theoretical conception of on-the-job training formulated by Becker (1964) and Stevens’ (1994) extension of this classic theory.

#### **4.2.1. Becker’s On-the-Job Training Model with Perfect Competition**

Becker formulated the foundations of the theory on investments in human capital by examining training in the firm. He argued that much of the skill and knowledge, or human capital, required to do a job could only come into existence if an investment in time and resources to create human capital is made. These investments are made through training and so it is important to understand the economic incentives to make investments in training (Blair, 1999:60). Becker’s book *Human Capital* (1964) provides an extensive discussion of on-the-job training as well as brief discussions on investments in schooling, information in labour markets and health. Becker states that on-the-job training is dealt with extensively not because it is more important than other kinds of investment in human capital but because it leads to a general theory that can be applied to all types of human capital investments. This general theory is reviewed next as it provides a comprehensive analytical foundation for understanding investments in human capital including those that take place outside of the firm.

Becker (1964) argues that on-the-job training increases worker productivity by allowing

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<sup>17</sup> Sen developed the Capabilities Approach to understand how the process of development can explain the human capability to have the freedom to live more freely, creating more valuable and worthwhile lives (see Sen, 1999)

workers to learn new skills and to perfect old ones. On-the-job training comes at a cost for firms, which includes the time and effort of trainees and trainers and the equipment and materials used for training. These resources could have been used for current production instead of being used to raise future output or in other forms of investment. This represents an opportunity cost for the firm and the size of this opportunity costs depends on the time spent on training a worker. The time spent training a worker varies according to the type of skills in which the worker is being trained. For example a machine operator will probably require less training than, say, a machine setter. Becker makes two key assumptions to construct his model. Firstly, he assumes that both labour and capital markets are perfectly competitive. Therefore a profit-maximizing firm would pay workers wages which are equal to their marginal product. Secondly, he also assumes that when the firm undertakes training, this lowers the firm's current receipts but raises its future receipts. Thus the firm will only undertake an investment in training when the cost of training is smaller than the return.

The key contribution of Becker's model is the differentiation between general and specific training. He defines general training as training that produces skills that can be used by both the training firm and many other firms. Becker gives the example of a machinist trained in the army whose skills can also be used in steel and aircraft firms. He defines specific training as training that produces skills that can only be used by the training firm. For example, Becker states that the army trains workers like astronauts, fighter pilots and missile men who are only useful to the military. The formal analysis Becker developed for investment into each type of training is now discussed in more detail.

### *General training*

General training increases the future marginal productivity of workers in the training firm as well as potentially in other firms. When training is completely or perfectly general it

increases the future marginal productivity of workers in the training firms and in other firms by the same amount. This creates an externality known as the “poaching externality” since non-training firms can obtain trained workers from training firms without incurring the costs of training. The total private return, which is the joint return to the worker and training firm, is therefore less than the social return, which includes the returns to non-training firms. Consequently, no rational firm in a competitive labour market would be willing to pay for general training because other firms can poach trained workers before it recovers the costs of training. Becker concludes that firms would only provide general training if they did not have to pay for any of the costs of training. The worker would be willing to pay for the costs of training because it will raise their future wages. Becker concludes, that it is workers and not firms that bear the costs of general training and profit from the returns. Workers pay for general training by receiving wages below their current marginal productivity.

### *Specific training*

Specific training results in specialised firm-specific skills that are of value to a specific employer, for example skills that reflect the nature of each firm’s knowledge management system and manufacturing routines (Nelson and Winter; 1982). Unlike general training, specific training is not of use to other firms and therefore only increases productivity in the training firm. Completely or perfectly specific training only increases marginal productivity in the training firm. Thus the training firms face no threat of poaching from other firms. Consequently, firms would be willing to pay for the costs of specific training because specific training would only benefit the training firm through increased profitability as a result of the worker’s increased productivity. Firms will only provide specific training when the expected benefits of the training are higher than the costs. Becker brings labour turnover into the discussion on specific training because a worker may quit before the firm has recouped its costs for training the worker and concludes that in

industries with high labour turnover firms would protect themselves by sharing the costs of training with workers. The firm would share the costs of training with the worker by paying them wages lower than their marginal productivity but more than they would receive elsewhere after training.

### *Becker's Conclusions*

Becker's model provides two major conclusions; the first is that the worker will pay for general training and the second is that the firm will pay for specific training. Although Becker's differentiation between general and specific training creates a neat analytical framework that has been very influential in economics literature, in reality not all skills fall in one category or the other. Indeed, Becker concludes that most "on-the-job training is neither completely specific nor completely general but increases productivity more in the firms providing it and falls within the definition of specific training (1975:26). He also states that when training is not completely specific it may increase productivity to some extent in other firms. He concludes that in this case most training is the sum of two components, a completely general component and a completely specific component. Therefore the greater the specific component of the training, the less it will increase wages in other firms relative to the firm providing the training.

Becker also recognises that some training may be useful not only to most firms or a single firm but to a set of firms defined by product, type of work and geographical location. He makes the example of a carpentry training that would raise productivity mainly in the construction industry. When training produces skills specific to an industry, these skills are general to firms in a given industry and "constitute an important component of a typical sectors' worker's human capital stock" (Neal, 1995:653). Becker concludes that training for industry-specific skills falls under general training and would be paid for by the worker because a single firm would not be able to readily collect the return to the training.



However, knowledge imperfections in the labour market mean workers may not recognise the gains in training and may underinvest in this type of training. Conversely, Becker also states that industry-specific skills are also similar to specific training if the industry instead of the firm is used as a point of analysis. So, the training is then specific to the industry and will therefore be funded by the industry. Indeed, Becker recognises, albeit in a footnote, that firms in an industry sometimes cooperate in paying for training costs, especially when training apprentices (1975:35). An example of this kind of cooperation are industry-training boards that are funded by the private sector to raise training and skills in the industry, through a training school or organised apprenticeships.

Lastly, although Becker's key assumption is that the labour market is perfectly competitive, the effect of the investment in training on worker productivity in other firms depends not just on the type of training, but also on the market conditions. For example, in imperfect labour conditions like a monopsony, a firm may be completely insulated from competition from other firms because in under this market condition it is the only buyer of skills. In this extreme case, basically all the firms' investments in training would be specific. So, Becker concludes that monopsony power increases the importance of specific training. Therefore the incentive for firms to invest in human capital is greater under these market conditions.

#### **4.2.2. Stevens' On-the-Job Training Model with Imperfect Competition**

Stevens (1994) extends the classic training theory developed by Becker to allow for imperfect competition in the labour market. Steven's model investigates how the returns to a transferrable training programme will be shared, as well as the implications of the poaching externality under imperfect competition. To construct imperfect competition in the labour markets, the model assumes a small number of firms that are subject to independent productivity or demand shocks, making them heterogeneous in the short run.

Stevens developed this model to explain why firms have been found to invest in general skills even though Becker predicted that no rational firm would invest in general training because of the poaching externality. Stevens argues that, “When firms have labour market power, a firm may obtain some return to an investment in training, in spite of the fact that the skills are transferable to other firms; in addition, since those other firms can also benefit from the investment there is an externality which may lead to an under-investment” (1994:537). Stevens’ model is now discussed in more detail.

### *Transferable training*

Stevens argues that Becker’s classification of general and specific training does not encompass all types of training, particularly the kind of training that takes place when firms face imperfect competition in the labour market. Stevens calls this type of training transferrable training, which she describes as training that is of some use to at least one firm in addition to the training firm but it is only of value to a small number of firms. The key difference between transferrable training identified by Stevens and general training, is the market conditions and the number of firms that can use the skills. General training assumes a perfectly competitive labour market with many firms and in which wages are equal to marginal product. In Stevens’ model there are only a few firms and they can set wages that are less than marginal productivity. As in Becker’s model, there is uncertainty about whether or not a worker will stay at the end of the training programme or leave for another firm that also values their skills. This poaching externality may result in an underinvestment in transferrable training. In Stevens’ model, skills that have a larger external market are seen as more transferrable than skills that can only be used by only two or three employees.

Stevens uses game theory to show what a firm’s training decision will be in these market conditions and how the training will impact on the labour market. Her conclusions are

discussed below.

### *Stevens' Conclusions*

The major conclusion drawn by Stevens is that in imperfect labour markets “not all transferable skills are general and for some types of on-the-job training for transferrable skills, firms – both the training firms and external firms – can obtain a positive share of the return to the training investment” (1994:557). Stevens argues that this may explain why firms have been found to invest in transferrable training. Stevens finds that in imperfect labour conditions the extent of the poaching externality depends on the degree of transferability of the skill between firms and the number of firms in the labour market, with the degree of the externality increasing as the number of firms in the industry increases. Industry-specific training fits the description of transferrable training because it is not general to all firms but only firms in a certain industry. In reality, firms in a given industry are often heterogeneous, resulting in imperfect competition in labour markets.

The link between training and imperfect competition shows that the acquisition of skills and skill requirements can also differentiate workers and firms. Under these conditions training can be a competition-reducing process. Firms may choose to differentiate their skill requirements in order to obtain market power in the labour market. Stevens argues that workers and firms are not identical as assumed in perfect competition since “...firms who use different combinations of specialised technology, or different patterns of work organisation, require workers with particular sets of skills and job experience.” (1994: 541). The training firm will benefit at the expense of the worker by reducing the transferability of the training because making workers less employable in other firms will protect the firm from losing workers to these firms.

### **4.2.3. Conclusion**

This section concludes on what can be drawn from the training literature. From Becker (1964) a threefold distinction between general, industry-specific and firm-specific training can be drawn. This distinction is very helpful as it sheds light on where one would expect this kind of training to take place and who should make the investment in the different types of training. Stevens (1994) argues that the type of training depends on how competitive an industry is, with less competitive market conditions resulting in relatively less transferrable skills. However, in more competitive conditions, firms will not want to invest in training that results in transferrable skills because this type of training leads to a externality where the training firm may not recover their costs for training if workers leave the firm before the costs have been recovered. The ways in which firms can use human capital to protect themselves from poaching will be discussed in section 4.3.3 on firm-specific training. Before this is done, the next two sections will discuss empirical evidence of the role of government, industry and firms in the formation of human capital through general and industry-specific training. This will further an understanding of how human capital formation may take place in Botswana's cutting and polishing industry and the role that the government, firms and training institutions can have in the development of different types of skills.

## **4.3. Empirical Evidence of Human Capital Formation**

With the theoretical understanding of general, industry-specific, and firm-specific skills in mind, this section explores the role of workers, governments, firms, and industry in the formation of human capital through general training, industry training and firm training.

### **4.3.1. General Training**

This section explores the role of various institutions, such as the government, external training providers and firms, in the formation of general human capital like basic literacy,

numeracy and communication skills, which can be useful to all firms in all industries and result from what Becker (1964) called perfectly general training. Von Krogh and Wallin (2011) call this type of human capital ‘individual capital’ because it is specific only to the individual but is generally used by all firms across all industries. General human capital is developed in the education system at the elementary, primary, secondary and tertiary level. Thus general training mainly takes place outside of the firm but when there is a market failure general training can take place in the firm. This section starts by discussing the role of government in the schooling system, followed by the role of the private sector in the provision of general training.

### *The Role of Government in General Training*

Due to market failure in the financial markets and poverty, many workers are unable to access the credit to invest in their general human capital. It is now widely accepted that government should play a key role in funding investments in human capital since human capital is a driver and facilitator of economic growth. Also, as noted above, knowledge imperfections in labour market may lead to an underinvestment by individuals in general human capital. All modern states assume the general responsibility for basic and even more advanced levels of education among the population to promote economic growth, social advancement and mobility (Crouch, 2005:98). Basic skills can be seen as a form of quasi-public good and no firm would be willing to pay for these skills because no profit can be made from this investment. Similarly, if enough people in the labour force possess basic skills, individual workers may also not invest in these skills since the private returns to these investments are low. Thus, most governments offer free basic education to their citizens through the public schooling system. This role of governments in investments in basic education is supported by UNESCO’s “Education for All” programme that aims to achieve universal primary education by 2015. This departs from Becker’s (1964) conclusion that only workers will pay for general training.

### *The Role of Private Education Providers in General Training*

Within the education sector, private education providers may play a key role in provision of general education. These independent or private schools may be financed and governed independently of the government. They are usually governed by an independent board of directors and financed through tuition fees and/or endowments. They can also be affiliated to various institutions such as churches and other religious institutions. Private schools tend to play a greater role when a country is still developing and the public education system has not been developed or the quality of public education is low. For example in the early nineteenth century when England and Wales were still developing, those who attended school went to private schools paid for largely by parents (West, 1995:2). Generally, over time, as a country develops public schools are introduced to the education sector but private schools can continue to play an important role in the education sector, and can even be subsidised by the government or have partnerships with the public sector (LaRocque, 1998).

#### **4.3.2. Industry-Specific Training**

This section discusses the provision of training that is not completely general, so it does not raise productivity in all firms across all industries, or completely specific, so it can raise productivity in more than one firm in the same industry. This is the type of training that Becker (1964) considered as specific to a particular industry and it results in industry-specific human capital. Von Krogh and Wallin (2011:269) define industry-specific human capital as the experience accumulated in a specific industry like supply-chain management, alternative product technologies, market structures and consumer preferences. They go on to explain that this type of human capital has an intermediary benefit to the firm and the employee because it puts the firm on a parity with its competitors and since it is transferable it enables mobility in the industry for the employee (ibid:269). Industry-

specific human capital can be formed outside the firm in industry training schools like vocational training schools, in the firm through on-the-job training, or through a combination of in-firm and out-of-firm training. Loewenstein and Spletzer (1999) used data from employment surveys to measure the specificity and generality of employer-provided training and found that most of the skills learned during on-the-job training are useful in other firms. So contrary to the theoretical conclusion made by Becker, employers have been found to share in the costs and returns of training that produces transferrable industry-specific human capital. Firms use a variety of institutional arrangements to protect themselves from losing workers to other firms in the industry. The different providers of industry training are discussed next.

#### *The Government's Role in Vocational Training Education and Training*

Vocational education and training prepares trainees for occupations or careers in different trades and crafts such as engineering, nursing and carpentry by giving the trainees technical or practical skills that can be used in the workplace in various industries. Vocational education and training can take place at the secondary or post secondary school (tertiary) level. There is a strong case for governments to play a role in the provision industry training that forms transferrable industry skills through government-led vocation training schools. Firstly, governments take a keen interest in the provision of technical skills because there is a widespread belief that the strength of the national economy depends of the quality and availability of technical skills in the workforce (Crouch, 2005:98). Secondly, due to the externalities that cause market failure in the provision of industry skills, investments in industry skills may be lower than what would be socially optimal since the social returns for these type of skills may be greater then the private return.

However, according to Crouch (2005), in addressing these market failures the state is not

necessarily the best or most efficient provider of skills for three key reasons. Firstly, the state's resources have to be divided between a number of competing claims so states may underprovide training. Secondly, tensions within the relationship between the state and the employers may make the state an inefficient provider of training. Thirdly, employers often find public institutions slow to respond to change. In other words,

“There is no reason to expect the state to always be a more efficient provider of training than the private sector firms are. Firms' skills requirements are highly idiosyncratic; government officials cannot expect to know the millions of needed aptitudes, let alone provide them. The appropriate response to these problems may be state finance, without state provision, of training” (Booth and Snower, 1996:11).

Since the industry is better able to assess its training needs, it generally makes for a better provider of industry-specific training. So government needs to play a role in regulating, stimulating and subsidizing the provision of vocational education and training (Ashton and Green, 1996, 17).

### *Industry Training Boards and Schools*

The market failure caused by the transferability of industry-skills that are sectorally specific, rather than systemically general, may call for industry collaborations that are driven by government and funded by the private or public sector. For example, South Africa has Sectoral Education and Training Authorities (SETAs) formed by government legislation, which are responsible for creating skills for the sector they operate in. The SETAs are also responsible for collecting skills levies from employers within each sector and make the money available within the sector for education and training. The German apprenticeship system and the Swedish government training programmes are often cited as



examples of how governments address market failure and can induce industries to undertake sufficient vocational training. In Germany, the government gives firms training subsidies and pays for the theoretical component of vocational training that takes place out-of-job in vocational schools. These examples show the different roles that the government may take in overcoming market failure in labour markets for technical training.

### *Firm Provision of Industry Training*

Firms play a key role in human capital formation since a large proportion of skills can only be learnt on-the-job in the firm through training and experience. Despite the market failure in the provision of transferrable training, such as training that produces industry-specific skills as identified by Becker (1964), empirical evidence shows that firms often provide industry skills and use “other institutional arrangements designed to stabilise employment and reduce turnover” (Blair, 1999:61) and hostages (Nübler (2007)). The notion of economic hostages refers to arrangements that hold rational actors to a particular economic relationship. For example Nübler (2007) argues that issuing training certificates only at the end of apprenticeship creates an economic hostage that provides workers with an incentive to stay with the firm until it has recovered its training costs. The next section discusses the role that different institutional arrangements, like hostages, have in making firm training more efficient when the training provided by firms can be used by other firms. This is followed by a review of the role of firms in providing industry-specific training in new industries and, lastly, the role of firms as specialised training providers.

### *Institutional Arrangements, Economic Hostages and Information Asymmetries*

Blair (1999) argues that organisational stability created by some types of institutions encourage many firms to provide training in general industry-specific skills especially through apprenticeship training. Apprenticeships are a form of training that enables

workers to learn a trade whilst working for a firm. The apprentice will continue to work for the firm for a certain amount of time after they have completed their training in order for the firm to recover the costs of providing the training. The apprenticeship is one of oldest forms of training and it goes as far back as the later middle ages. In the medieval era, the guild system protected the master craftsman who trained the apprentice in industry-specific skills by enforcing a training contract. The master craftsman would demand rights over the apprentice's labour to recover the costs of training through long-term training agreements that would be upheld by formal or informal sanctions (Epstein, 1998). The master would raise the apprentice's costs of default by demanding entry fees and by setting the apprentice's wages on a rising scale with the highest payoffs upon the fulfilment of the contract (Epstein, 1998:691).

The modern apprenticeship system often combines both practical and theoretical elements. For example, in Germany theoretical training takes place in formal schools whilst the practical component takes place in firms, so training is both on-the-job and off-the-job, creating a dual training system. The role of vocational training in the German system and the institutional foundations it is based on, have attracted attention because of their ability to create specific industry skills, particularly in manufacturing, that foster high-quality production (Riain, 2011).

Nübler (2007) found that institutions play a crucial role in providing firms with an incentive to finance modern apprenticeship training. As in the medieval guild system, they do this by providing a credible commitment to the firm that the apprentice will stay until the firm has recovered its training costs. Nübler uses game theory to argue that institutions help to overcome market failure when firms train in transferrable skills by changing the apprentice's pay-off and incentive structure to make cooperation the rational strategy for the apprentice. The training firm only issues the final apprenticeship certificate at the end

of the training program and if the apprentice breaks the contract “the firm will destroy the economic hostage which has no value to the firm, but high value for the worker” (p. 68). In this way, the institutionally provided hostage gives the firm an incentive to train workers in general industry skills. Furthermore, Nübler (2007) found that in traditional apprenticeship systems in West African countries, firms relied on informal institutions, for example:

“...the firm proposed the formal apprenticeships training to those workers whose family members worked in the company as unskilled workers. ...By employing a critical number of relatives, the firm created an economic hostage which it could destroy if the trained worker attempted a hold-up on the firm’s training investment. The firm would simply dismiss all the relatives. The worker was aware of the hostage posting and the threat of the firm to destroy the hostage in case of opportunistic behaviour”.

This example shows that institutionally created hostages do not have to be formal like in the case of training certificates – it is sufficient for them to be enforceable and thus reassure the firm that it will recover the costs of its investment in transferrable industry-specific training. Thus it is important to investigate if the cutting and polishing firms use any hostages to recover their costs of training.

Lastly, information asymmetries can also play a role in protecting the training firm from losing workers to other firms in the industry. Katz and Ziderman (1990) and Acemoglu and Pischke (1998) argue that asymmetric information can cause training that is general to be perceived as specific by other firms simply because they do not know that the training the worker received in another firm can raise productivity in their firm. Thus it would be important to ascertain perceptions on the transferability of training in Botswana’s cutting and polishing industry.

### *New Industries*

When a new industry emerges, training takes place in the firm due to an initial lack of industry training schools. Over time, as the new knowledge and skills used by the industry become more competitive due to increased demand for them, they can be taught inside training institutes.

“The early development of the engineering industry in the eighteenth century, like that of information technology in the late twentieth century, saw relatively uneducated men experimenting in unsystematic ways. Later, however their knowledge was systematised, codified, and taught” (Crouch, 2005: 111).

In a new industry, when training schools and the industry have not yet provided training, individual firms can plan an important role in training provision. Training schools can start to respond to the industry's need once training programmes have been developed, the industry's longevity has been assessed, and the level of demand for new skills has been determined. This goes back to Stevens' (1994) point on the market conditions in the labour market determined by the number of firms in the market; in a monopsony all firm training is specific but as more firms enter the labour market it becomes more competitive and training becomes more general. Thus given the infancy of Botswana's diamond cutting and polishing industry, it is important to investigate how the degree of competitiveness in the industry's labour market is impacting on the scope for institutional training.

### *Firms as External Training Providers*

Training can also take place outside the enterprise when firms outsource it to specialised training providers. Grieg (1997:186) states that external training is the most appropriate form of training when: (1) equipment is costly and risk of damage is high, (2) technology is new, (3) numbers of trainees are manageably small, (4) employment levels are high, and

(5) the primary concern is with the acquisition of knowledge rather than the application of skill. Thus the training needed is relatively more theoretic than practical. Another incentive for firms to outsource their training is that they can focus all their resources on production instead of diverting some to training. However, due to the firm-specific nature of specific skills they can often only be acquired through on-the-job training. Nonetheless, more general skills like industry-specific skills can be acquired through external training.

Greig (1997:190) also states that basic training in craft skills is usually best provided externally but large firms may conduct training equally well internally. Furthermore, countries at the early stages of industrialisation may place a greater emphasis on off-the-job training for craft apprentices in engineering and construction in order to deal with skill shortages quickly (ibid: 199). Another reason that firms may use off-the-job training is because, “Even where the appropriate institutions for training trainees exist, they may lack enough people with the relevant experience and status to develop and manage a large-scale trainer-training activity so individuals of this calibre are much more likely to be attracted to mainstream management roles in production, marketing and finance.” (Grieg, 1997: 191). Lastly, since the trainer often also needs to be trained, the unavailability of trainers for some skills may encourage the firm to outsource the training for these skills or to get their employees trained so they can train other employees.

#### **4.3.3. Firm-Specific Training**

This section discusses the role of the firm in the provision of completely specific training that Becker defined as being of use to only the training firm. Examples of firm-specific human capital are the knowledge of the company’s budgeting processes, product descriptions and human resource procedures (Van Krogh and Wallin, 2011:269). Empirical evidence provided by studies of layoffs suggests that long tenure employees experienced a pay cut in their new jobs after they had been laid-off through no fault of their own,

showing that they had been earning more than their short-term opportunity costs (see Topel (1990), and Jacobson, LaLonde and Sullivan (1993) who show that firm-specific human capital could be about 10 per cent or more of the total wage bill in the corporate sector (in Blair, 1999:62)). A firm can gain a competitive advantage from firm-specific training when its competitors cannot easily replicate it. Although firm-specific human capital is most valuable to the training firm by increasing its competitive advantage, it is least valuable to the employee as it is non-transferable and reduces mobility (Van Krogh and Wallin, 2011:269).

Since the investment in firm-specific training raises marginal productivity in the training firm more than in other firms, this extra output can be seen as a rent because it results from the firm's command or ownership over a scarce resource. How this rent is shared between the worker and the employer results in a dilemma known as the 'hold-up' problem where "either party can 'hold-up' the other party by threatening to end the relationship unless he captures most the rents" (Blair, 1999:60). This section therefore focuses on the theoretical understandings on the various mechanisms that the firm can use to solve the 'hold-up' problem such as contracts, institutional arrangements and corporate governance structures. The next section will discuss how firms organisation routines can increase the specificity of training, reducing the threat of poaching.

### *Organisational Routines*

This section moves beyond the formation of human capital in the firm to how firms *use* the skills and knowledge of workers in their organisation to make them more competitive by being less vulnerable to poaching. Becker's (1964) model shows that the major problem with the formation of human capital in the firm is that the training firm may not recover the costs of its investment if workers are lost to other firms when the skills are transferrable. However, Stevens' (1994) model shows that in imperfect competition, skills can be a

competition-reducing factor if firms are able to make them less transferrable to other firms. So it is important to understand how firms can use firm-specific training to protect themselves from poaching by making training less transferrable to other firms and making the firm more competitive.

Firm theory shows how firms can make skills less transferrable by using their routines to ensure the skills of their workers are specific to their firm. Coff (2011) argues that since firm-specificity reduces worker mobility, firms can implement more firm-specific routines so that comparable jobs are hard to find. The concept of firm routines was put at the centre of organisational and economic change by Nelson and Winter (1982) in their book *An Evolutionary Theory of Economic Change*. Winter (1964) defines routines as a “pattern of behaviour that is followed repeatedly, but is subject to change if conditions change” (p. 263). Nelson and Winter (1982) state that skills refer to the individual level whilst routines refer to the organisational level. In the context of the firm, routines are the organisational procedures used by management to produce goods and services. Teece, Pisano and Shuen (1997) argue that the way the production is organised (i.e. the firm routines) by management inside the firm impacts on the firm’s ability to react to changes in the external environment. So routines are crucial to the firm’s competitiveness in a dynamic environment.

Routines are context dependent and embedded in the firm’s or organisation’s structures (Teece and Pisano, 1994). So every firm will have routines that are specific to it. Nelson and Winter (1982) state that routines are an important way of storing an organisations specific knowledge. The firm’s productive knowledge, such as what inputs to use and how to use them to produce the firm’s goods or services, is often kept as a trade secret that is guarded closely for competitiveness reasons. In this way, a firm can use its routines to limit the individually held knowledge of the firm’s productive process. When a firm’s

production process is a trade secret, the firm can split up the process amongst the workers so that no individual worker has knowledge of the entire production process. Thus if a worker were to leave the firm to work for a competitor, the firm's productive process would be protected. In this way, the firm would have used its routines to make its human capital specialised, ensuring the workers' skills and knowledge are less transferrable to other firms. The firm would then be willing to train workers in these firm-specific skills because the likelihood of losing its investment to other firm has been decreased.

### *Contracts*

Contracting problems arise when the firm and its workers, make an investment training that is specific to their relationship, this training results in firm-specific human capital. Klein, Crawford & Alchian (1978) argue that when these contracting problems arise, either party can use hold-ups or hostages to ensure that they can expropriate returns from their investments. However, explicit or implicit contract solutions are relatively more complicated with regard to human capital than other firm assets such as specialised equipment. "Since the contracting problems surrounding investments in firm-specific human capital are so pervasive, it should not be surprising to find that providers of human and financial capital have developed noncontractual mechanisms [such as discretionary bonuses and private health insurance] for encouraging and protecting firm-specific investments" (Blair, 1999:75). These mechanisms are either around institutions or corporate governance. These mechanisms are to encourage long-term employment relationships when investments in firm-specific capital are made.

### *Institutional Arrangements*

According to labour theory, as firm investments in firm-specific human capital cannot be protected by contracts, other institutions are needed that "have the effect of tying the fortunes of the employee with those of the firm" (Blair, 1999:63). Using the insight



provided by Becker (1964), Doeringer and Piore (1971) developed the theory of internal labour markets, which argues that investments by firms in specialised or firm-specific training encourage firms to develop and implement institutional frameworks that can stabilize employment and reduce turnover, enabling the firms to make further investments in specific training.

These institutional frameworks can be specified in the firm's corporate governance structures and policies. Williamson (1985) argues that firm-specific human capital investments must be "embedded in a protective governance structure lest productive values be sacrificed if the employment relation is unwittingly severed". This protective governance structure give the worker job security and can include severance pay to protect workers if the employer terminates their employment and pensions to discourage workers with specialised skills from quitting. They can also include structured promotion guidelines to map the worker's career path in the organisation. This creates a positive relationship between the length of time the worker spends in the organisation and their remuneration, thus tying the fortunes of the worker to those of the firm.

#### **4.4. Analytical Framework for Training**

The analytical framework for training developed here will be used in the chapters that follow to analyse the empirical evidence on human capital development in Botswana's education and vocational training system and in the cutting and polishing industry.

The literature shows that the formation of basic skills through general training can take place in the public education system and the private education system. In contrast, the formation of industry-specific skill through industry training can take place through government-led vocational and education system, or industry-led training boards and schools or through apprenticeships, and in the firm through on-the-job training or off-the-

job training or a combination of the two. The skills level of a country, resulting from what Riain (2011) terms as the human capital formation regime, can constrain or enable firms production strategies (Riain, 2011:595). Thelen (2004) argues that a country's social institutions determine the skills composition in its labour force. German and Japanese workers have deeper sets of specific skills because of the high provision of firm training and apprenticeships, whilst workers in more liberal economies like America have more general skills making workers more mobile across industries (Thelen, 2004). Skill composition, or the relative amount of general and specific skill, of workers varies according to their occupation.

Interestingly, firm-specific training, unlike industry-specific training can only take place in the firm. With firm-specific investments it is crucial that quit rates are low. Becker (1964) argued that whether or not the firm will pay for specific training depends on labour turnover. In the analysis of Botswana's diamond cutting and polishing industry, it is important to understand the extent of labour turnover and the strategies firms use to reduce turnover.

Since the cutting and polishing industry is a traditional craft industry, the last section of this literature review discusses how technological changes that have taken place in other traditional craft industries have impacted on human capital requirements in those industries.

#### **4.5. Technological Changes in Other Craft Industries**

Diamond cutting and polishing is a classic craft industry based on traditional skills and knowledge that were developed over many years (Watermeyer, 1980). Therefore understanding what has happened to craft skills and knowledge in other industries is central to understanding what could happen to human capital formation in Botswana's

diamond cutting and polishing industry. In recent decades, craft skills and knowledge used in industries like tool making, metalworking, and printing have been undermined due to technological advances like Computer Numerical Control, Computer-Assisted Design and Computer-Assisted Manufacturing (see Sennett 2008, Matthew 1989 and Kaplinsky, 1984). Similarly, in past centuries, skills and knowledge used in ancient crafts like glassmaking, weaving, medieval goldsmithing, cloth making and hand stitching have too been undermined mainly by technological changes that resulted in mechanisation. These technological changes have undermined the tacit knowledge that had been developed in these manufacturing industries over centuries.

Before large factories became the dominant feature of the industrialised world, most products were produced in small-scale cottage industries. “The pinnacle of this system was the proud and highly skilled master craftsman, who owned his own tools, hired his assistants, brought his own materials and sold his products directly to the market” (Matthews, 1989:11). In his book *The Craftsman*, Sennett (2008) describes a craftsman as one who does a job well for its own sake, so craftsmanship is founded on a skill developed to a high degree (2008:2). For psychologist, a defining feature of a craftsman is that it takes at least ten thousand hours<sup>18</sup> of experience to become a master at any craft (see Levitin (2006)). Most craftsmen belonged to a guild, which were associations for particular trades, and training, mainly through apprenticeships, took as long as seven years. After the industrial revolution major changes took place in the organisation of work in many industries as mechanisation advanced. This and other factors eventually led to the demise of the guilds as many crafts skills became obsolete (Epstein, 1998).

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<sup>18</sup> This is equivalent to about 5 years of a 8 hour a day job (weekends not included) with 252 working days a year.

### *Knowledge Codification*

In modern times, the work of a craftsman is threatened not only by the physical power of machines but by their ability to comprehend knowledge that was previously embodied by the craftsman. As Sennett (2008:39) argues,

“Since the Industrial Revolution of the eighteenth century, the machine has seemed to threaten the work of artisan-craftsmen. The threat appeared physical, industrial machines never tired, they did the same work hour after hour without complaining. The modern machine’s threat to developing skill has a different character.”

It could therefore be argued that, through the process of knowledge codification, tacit knowledge became explicit enabling technological changes that significantly undermined the craft skills and knowledge that had been acquired after many generations. One of the most accepted definitions of knowledge is by Michael Polanyi who defined two types of knowledge in his book the *Tacit Dimension* (1966), explicit knowledge and tacit knowledge. Explicit knowledge can be expressed in words and numbers for example data, scientific formulae, specifications, manuals and so forth. This kind of knowledge can be easily passed on between individuals formally and systematically. Polanyi (1966:4) stated that ‘we can know more than we can tell’ because most knowledge cannot be put into words. This tacit knowledge is highly personal and is deeply rooted in a person’s action and experience as well as their ideals and values or emotions. This makes this kind of knowledge difficult to share with others; it can only be learned by experience and communicated indirectly.

Nonaka and Takeuchi (1995) explain that there are two dimensions to tacit knowledge, technical and cognitive. The technical dimension encompasses the kind of informal personal skills or crafts referred to as “know-how”. For example a master craftsman develops a wealth of knowledge after years of experience but is often unable to articulate the scientific or technical principles behind what he knows. The cognitive dimension consists of beliefs, ideals, values, schemata, and mental models that are deeply engrained in people and the authors argue that we often take this dimension of tacit knowledge for granted. The cognitive dimension is even harder to articulate and this dimension of tacit knowledge shapes the way we perceive the world and can be referred to as the “knowing what” compared to the “knowing how” of the technical dimension of knowledge.

In traditional systems of production, technologies and production processes were relatively stable and were well known by the artisan or craftsman having been passed to him through an apprenticeship or membership of a guild (Matthews, 1989:11). The tacit knowledge used in each craft was a trade secret that was protected by the guild but as modernisation and industrialisation advanced more and more of this tacit knowledge was codified. For example, *The Encyclopedia, or Dictionary of Arts and Crafts* edited by the French philosopher and writer Denis Diderot in the second half of the 18<sup>th</sup> century is described by Sennett (2008:91) as a “bible of craftsmanship” because it used pictures and words to describe the knowledge and techniques used in an extensive range of craft industries. As the knowledge used in the craft industries was codified and therefore better understood, machines were then invented that eclipsed tools and craftsman, enabling many production processes to be mechanised.

The codification of tacit knowledge is key to technological change as it creates a form of knowledge that is separate from the worker and can therefore be used in the creation of new technologies. The codification of tacit knowledge is important because “[t]he process

by which knowledge or information evolves and spreads through the economy involves changing its nature between tacit and codified forms” (Cowan & Foray, 1997:595). Codified knowledge is easier to diffuse than tacit knowledge because the individual does not embody it. New knowledge starts in a tacit form but over time it become more codified (Cowan & Foray, 1997:595). “As it is explored, used and better understood, less of it remains idiosyncratic to a person or a few people, and more of it is transformed into some systematic form that can be communicated at low cost” (Cowan & Foray, 1997:595).

### *Digitisation*

Furthermore, across many manufacturing sectors, the codification of tacit knowledge enabled this knowledge to be written into the routines of electronic equipment through the process of digitisation. This allows different types of information to be captured in a single binary code that can be used in computing and telecommunications. This form of codified knowledge also allows for the mechanical replication of the skills of workers through automation. Digitisation led to new technologies like Computer Number Control (CNC) machines, which are programmable machines that revolutionised modern manufacturing by enabling the automation of machine tools. CNC systems advanced further allowing for highly automated computer-aided design (CAD) and computer-aided manufacturing (CAM) programs.

Since an increasing number of machines are now controlled by similar digital logic this has enabled Computer Integrated Manufacturing (CIM) “where all computer generated data are pooled and exchanged – from design, manufacturing, planning and finance” (Matthews, 1989:43). Therefore “the production of information, its storage, its manipulation, its presentation and its transmission” (Kaplinsky, 1984:81) can now be coordinated. In other words, in computer integrated manufacturing the conceptual or design process undertaken at the front end of the manufacturing process is digitised, and the subsequent

manufacturing processes are automatically set-up by the formerly tacit routines, which are also incorporated digitally in the design process. This automation “involves the coordination between activities in different spheres of production” (Kaplinsky, 1984:26), such as the design and manufacturing sphere. Interestingly, because of the advance of Information and Communications Technology (ICT), designs and information can be transferred between countries. Therefore the design stage can be physically separated from the digitally controlled manufacturing, often between continents.

### *Deskilling the Craftsman*

Digitisation saves labour by automating processes and optimises manufacturing routines, providing much greater accuracy than manual workers can achieve and improving the quality of the resulting products. However, this unfolding process has had major implications for skills in sectors that previously relied on the expertise of craftsman by making their skills obsolete. This is the process of deskilling, where the use of skilled labour is reduced in an industry or sector due to the introduction of technologies that can be operated by semi-skilled or unskilled labour. Since workers employed in the production process become less skilled, smaller investments in human capital are needed in these industries or sectors.

The deskilling argument was put forward famously in the labour process literature by Braverman (1974) who revisited Marx’s analysis of the labour process and argued that the capitalist system aims to control the worker by transferring their skills and their codified tacit knowledge to machines. Braverman believed that through management work process the labour process become the responsibility of the capitalist, and to have control over the labour process it was essential that power passed from the hands of the worker to the capitalist by progressive alienation of the process of production from the worker. He stated that:

“The separation of mental work from manual work reduces, at any given level of production, the need for workers engaged directly in production, since it divests them from time-consuming mental functions and assigns these functions elsewhere.” (Braverman, 1974: 125).

Braverman criticised Taylor's scientific management of work that he developed in the late 19<sup>th</sup> century, arguing that it was an attempt to apply methods of science to the increasingly complicated problems of the control of labour in rapidly growing capitalist enterprises. The first of these principles states that management needs to develop a science for each element of work and to replace the rule-of-thumb method or in Taylor's words:

“The managers assume... the burden of gathering together all the traditional knowledge which in the past has been possessed by the workman and then classifying, tabulating and reducing this knowledge to rules, laws and formulae” (Taylor, 1911:36)

The second principle is that work should be divided equally between management and workers so that management can ensure that work is managed scientifically, whilst the workers actually carry out the work or as Taylor described it:

“All possible brain work should be removed from the shop and centred in the planning and laying out department” (Taylor, 1911:105)

The third principle states that management should provide workers with detailed instructions and ensure that the workers follow the scientific method prescribed by management. Essentially, Taylor's principles were about the separation of the worker from



mental work through the codification of the workers tacit knowledge by management to enable manufacturing to be managed scientifically. The aggregation of production in factories enabled scientific management of work, which fostered and reinforced the process of mechanisation. According to Braverman, this control could only be achieved by treating the workers themselves as machines. He argued that Taylor's first principle was based on the dissociation of the labour process from the skills of the workers. In this way, it rendered the labour process independent of the craft, tradition and knowledge of workers so that work no longer depended on the workers' abilities but rather the practices of management. Braverman stated that Taylor's second principle entailed the separation of conception from execution. Marx has himself made the key distinction between execution and conception in work in the following way:

“A spider conducts operations that resemble those of a weaver, and a bee puts to shame many an architect in the construction of her cells. But what distinguishes the worst architect from the best of bees is this, that the architect raises his structure in imagination before he erects it in reality. At the end of every labour-process, we get a result that already existed in the imagination of the labourer at its commencement” (Marx, 1864:116).

Braverman argued that management control and decreased labour costs could only be achieved if the study of work processes is only done by management and only communicated to workers through instructions for the simplified job tasks which they can follow without thinking or comprehending the technical reasoning behind them. Lastly, Braverman said that Taylor's third principle was based on the monopoly control of knowledge in order to control each step of the labour process and how it is executed. Modern management is based on Taylor's principles and Braverman argued that these principles led to the deskilling of the worker, contending:

“Modern management came into being in the basis of these principles.... It was to ensure that that as craft declined, the worker would sink to the level of general and undifferentiated labour power, adaptable to a large range of simple tasks, while as science grew, it would be concentrated on the hands of management” (Braverman, 1974: 120-121)

In summary, Braverman’s deskilling thesis predicts that mechanisation will lead to a decline in the craft skills of workers, increase the separation of mental and physical labour, decrease investments in human capital, such as, training and increase the specialisation of labour. Similarly, Noble (1979) argues that Numerical Control (NC) was developed to enable management to take control away from the shop floor by undercutting the skills of the machine operator. Shaiken (1980) made this same point with electronics, arguing that by creating more flexibility in the production process, management undercut the basis for skilled, labour-intensive batch production thus eroding the craft skills in manufacturing.

However, Braverman’s deskilling thesis has been widely disputed mainly due to limited empirical data showing that workers are indeed deskilled when new machines are introduced to the production process. Some studies have found empirical evidence of Braverman’s deskilling thesis, for example Wallace and Kalleberg (1982:307) used a time-series analysis of data from the printing industry from 1931 to 1978 and found that “skills levels in the industry have indeed declined and, moreover, that these declined are largely due to the shift to more capital-intensive printing techniques”. Yet much research has found no evidence of deskilling and concluded that Braverman’s thesis does not hold. For example, Jones (1982) disputed the deskilling theory with empirical evidence showing a redistribution, rather than a reduction, of skills in engineering resulting from the introduction of NC machine tools in Britain. Finchman (1983) also disputed the deskilling

thesis with empirical evidence from two large engineering companies in Scotland that demonstrating that the introduction of NC and CNC did not result in deskilling. Similarly, Keefe (1991) investigated the impact of NC tools in the machinery industry in the USA and found no significant change in average skills levels of workers after 30 years of the introduction of NC machine tools. Martin (1981) and Cockburn (1983) investigated automation of the national press in Fleet Street and found no evidence of deskilling associated with the computerisation of the production process. Zicklin (1987) compared the effects of numerical NC on the skills of machinists using NC machine and machinists using conventional machines and found that the use of NC machines did not lead to deskilling.

#### *Technological Change can Result in New Skills*

During the era of cottage industries workers needed to possess mainly craft skills. Today, in an era of high technology, workers needed a different mix of skills; this mix includes relatively more modern knowledge about new technologies such as computers and lasers. Workers used to get trained in skills that they used all of their lives, now the skills requirements of a job change regularly during a lifetime as the technology changes rapidly. Mitchell (1998) states that:

“During the early stages of industrialisation, the principles of scientific management and work organisation devised for mass production had the effect of breaking down complex work processes into simple, repetitive tasks carried out by less-educated and less-skilled workers, under close supervision and using simple technologies. In the new and infinitely more complex work environment, in which mass production is giving way to customised production and where product life cycles are becoming ever shorter, the labour force needs to be better educated and more highly skilled, while enterprises are compelled

to seek innovative responses to more sophisticated technology.” (Mitchell, 1998:3)

In response to the new skills required by new technologies, Penn and Scattergood (1985) challenge Braverman’s theory of deskilling with a new theory they have advanced, the compensatory theory of skill. The authors argue that they put this theory in order to extract themselves from the problem of “Bravermania” caused deductive reasoning based on history and its romanticised view of craft work. The compensatory theory of skill argues that technology generates both skilling and deskilling effects and in developed societies these effects are international. In other words, technological change tends to deskill productive roles but it also increases demand for a range of ancillary skilled tasks. For example, although CNC led to a decrease in demand for manual workers, it led to an increased demand for computer programmers who can write the programs needed to control the machines (Penn and Scattergood, 1985).

Penn and Scattergood (1985) conducted empirical research to support their compensatory theory of skill by investigating the impact of technological change on skills in three paper mills in the Britain. They found that the computerisation of two main production processes had led to a rapid increase of maintenance skills and had required new computer-usage skills. They also found that traditional knowledge was still very crucial to the production processes. Similarly, Penn (1986) analysed the changes in skilled labour in the USA between 1940 and 1980 and found that there was no support for Braverman’s argument at the aggregate level of skill in a range of craft occupations paper due to proportion increases in skills like maintenance that compensated for loss of skills in occupations like tool making.

Unlike the deskilling thesis, the compensatory thesis is more in line with current trends in the labour markets as while workers are seen to require fewer traditional skills, they need new, more modern skills. Technological changes like CAD, CAM and CIM result in new skills requirement in the maintenance of electronic machines and the programming and operation of computers. Furthermore, new technologies do not result in a complete erosion of craft skills since the front-end design process often requires an intimate knowledge of the manufacturing process. For example in metalworking, workers in front-end design need to understand the behaviour of different types of cutting, bending, joining and welding. Overall, the actual operation of the machines is no longer a manual job and the number of craft skills required in design is relatively lower than those, which occurred before.

Technological developments have resulted in changes in the human capital required by workers in many industries that previously has relied mainly on tacit craft skills. These changes have decreased the importance of the traditional craft skills, whilst at the same time increasing the importance of more modern skills like the programming and maintenance of new technologies. Therefore, investigating technological changes that have or are taking place in diamond cutting and polishing is crucial to understanding the development of human capital in Botswana's nascent diamond cutting and polishing industry.

#### **4.6. Conclusion: Summary of the Key Issues in the Literature**

This section concludes the literature review by summarising the key issues drawn from the literature and how they will be addressed in this research.

Firstly, the concept of rents is very relevant to understanding the role that resource rents have had in the development of Botswana's diamond cutting and polishing industry. Political will is important in understanding how the government has fostered value-added

in Botswana's diamond industry through the development of local cutting and polishing capacity. The concept of rents is also relevant in explaining how human resources are key to reaping entrepreneurial rents at the firm level. Human resource accumulations are key to explaining competences in the global diamond cutting and polishing industry. It is important to understand how developed diamond cutting and polishing centres have created their human resources and how Botswana can learn from their experiences.

Secondly, the human capital literature is relevant to understanding human capital formation within and beyond the firm. The literature identifies a market failure in firm training when it results in transferrable skills like industry-specific skills. This market failure can lead to an under provision of transferrable training. Since, as will be shown in subsequent chapters, most of the industry-specific human capital formation in Botswana's diamond cutting and polishing industry takes place in the firms, it is important to understand how training takes place in the firms, the key issues faced by the firms and the extent to which poaching is a problem. It is also important to understand the role that the government and different institutional arrangements are playing in overcoming the market failure. It is also important to understand the role of human capital formation in Botswana through the schooling and vocational training system to meet the diamond cutting and polishing industry's needs. Furthermore, the utilisation of the skills by the firms can also play a key role in overcoming the market failure by making sure the workers' skills or the labour process represent a firm's specific routines. So it is also important to understand how the cutting and polishing firms use their workers' skills and knowledge within their various organisational routines to protect themselves from poaching.

Thirdly, technological developments have led to changes in the mix of skills needed by workers in other traditional craft industries. Thus it is important to understand the technological changes taking place, if any, in the diamond cutting and polishing industry

and how these changes will impact on the firms' training requirements. In order to aid the investigation of how human capital formation takes place in Botswana's cutting and polishing industry through the education system, training institutes and the firms, the next chapter investigates the human capital requirements in the cutting and polishing firms.

## **Chapter 5:**

# **The Human Capital Requirements of Diamond Cutting and Polishing Firms**

### **5. Introduction**

This chapter aims to understand the nature of the human capital challenge faced by the diamond cutting and polishing industry. It investigates the skills, knowledge, and capabilities needed throughout the production process within the factory and beyond, both in terms of production and non-production jobs. The human capital requirements will be grouped according to Becker's (1964) classification of general and specific (industry-specific and firm-specific) skills, as discussed in Chapter 4. Once these human capital requirements have been identified, the next three chapters will investigate the extent to which they are met by the education system, industry training institutes and the firms. This will provide some insight as to where and how efficiently the formation of the different types of human capital is taking place in the economy.

This chapter will start by describing the manufacturing process used to cut and polish diamonds, as it is important to have a basic understanding of this process in order to assess the human capital needed throughout the different production processes. This is followed by a description of the breakdown of the human resources requirements in a cutting and polishing firm in order to understand the relative importance of the different jobs in a typical cutting and polishing firm. Lastly, the chapter will describe the general, industry-specific and firm-specific human capital required for the different production jobs and for various non-production jobs in the firm.

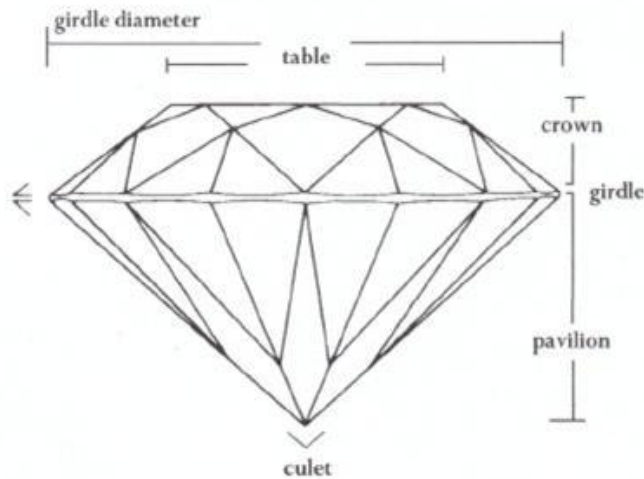


## 5.1.The Craft of Cutting and Polishing Diamonds

The craft of cutting and polishing diamonds originated in India and Europe, dating as far back as the tenth century. It took many centuries to develop because it is a very difficult and precise craft that requires a high level of skill and knowledge, as well as specialised tools and equipment to reveal the “hidden beauty” of rough diamonds (Klein, 2005:38). In comparison to a polished diamond, a rough diamond is dull looking and could be mistaken for a piece of broken glass or a pebble. Polished diamonds are cut to specific shapes depending on the shape and crystal qualities of the rough diamond. The rough diamond determines the types of polished diamonds that can be manufactured. This is similar to how a log determines the wood products that a carpenter can make from it (Interview, Gaborone, May 2011).

The shape and angles of a polished diamond determine how it refracts and reflects light, which in turn determines the extent to which it sparkles. The most popular shape of polished diamond is the ‘round cut’. Although there are other polished diamond shapes such as oval, emerald and princess cuts, the majority of rough diamonds are turned into round diamond cuts. By the 1980s, round diamond cuts accounted for over 98 per cent of polished diamond production and due to mass production techniques, it is the cheapest to produce (Watermeyer, 1980:102-103). The optimal proportions of the round brilliant diamond cut were perfected and published by Marcel Tolkowsky in his book *Diamond Design* (1919). Tolkowsky, who is seen as the ‘father’ of round diamond cut, came from a family of Belgian diamond cutters and being a mathematician as well as a diamond cutter, he was able to use this knowledge to uncover the proportions that a polished diamond needed for maximum light return or ‘brilliance’. Figure 5.1 shows a diagram of the basic structure of a round brilliant polished diamond.

**Figure 5.1: Round brilliant polished diamond**



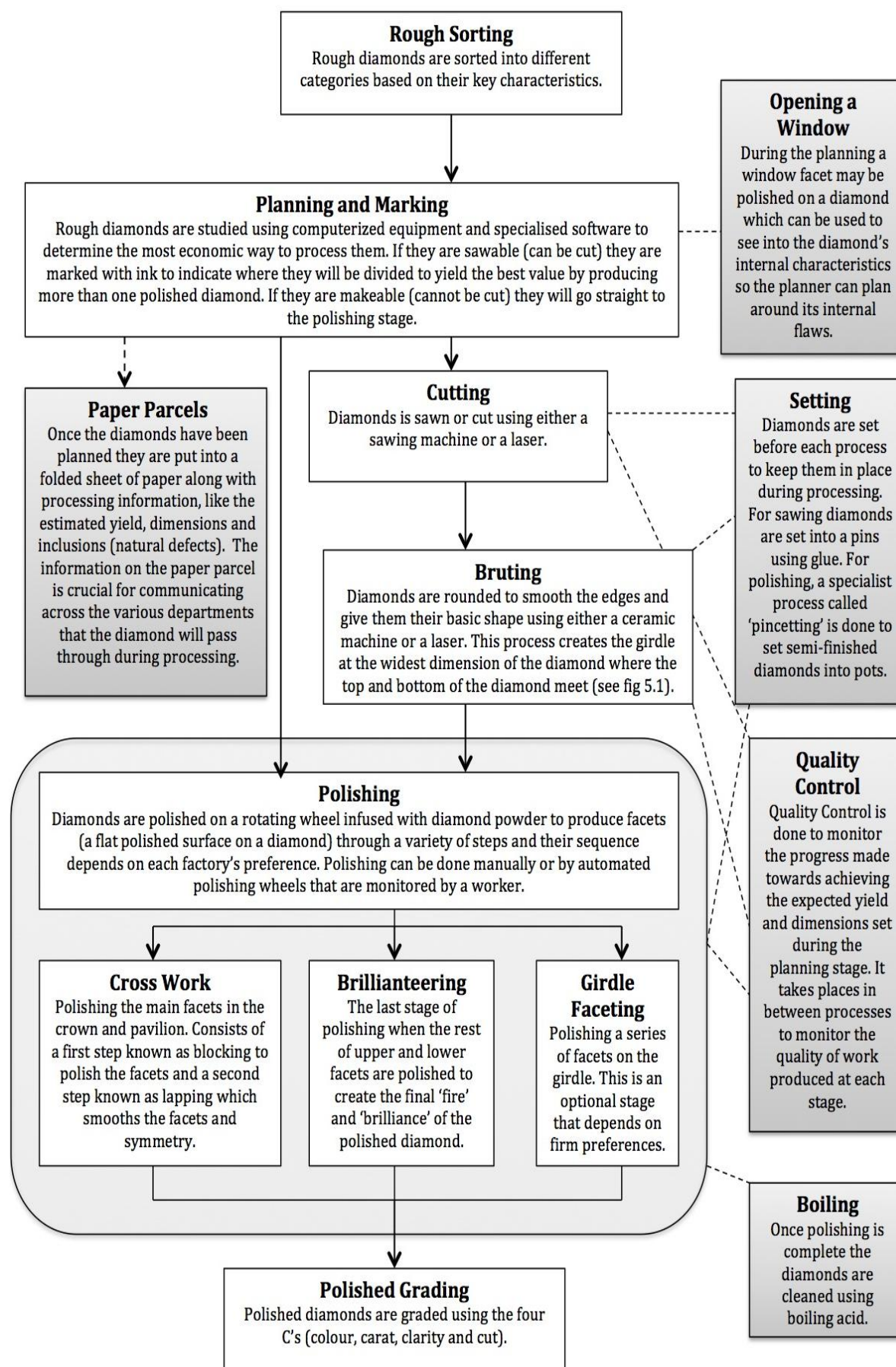
Source: <http://www.tesoroboston.com/education-diamonds.html>

The light enters through the top of the diamond known as the “table” and reflects or hits back at the bottom diamond, the “pavilion”, which acts as a prism to reflect light back to the top of the diamond where it is reflected and dispersed through the facets (flat polished surfaces) on the top of the diamond or the “crown”. As the light leaves the diamond, it creates the sparkly effect that distinguishes polished diamonds. So the aim of polishing diamonds is therefore to produce this sparkle. As Klein (2005:38) puts it, “Nature made the diamond, but only man can cut and polish it to reveal its hidden beauty”.

## **5.2. The Manufacturing Process**

Using fieldwork research and secondary sources where indicated, this section explains the various stages of the diamond cutting and polishing manufacturing process (se Figure 5.2). This will lay the foundation for understanding the skills and knowledge needed at each stage.

**Figure 5.2: The manufacturing process**



Source: fieldwork research

### *Rough Sorting*

Diamonds need to be prepared before manufacturing, starting with the sorting of the rough diamonds. The rough diamonds are grouped according to their key crystal characteristics, which determine the diamonds adaptability to being cut (Klein, 2005). As rough diamonds are formed, they develop a grain structure and take various shapes falling under three general categories: sawable, makeable and cleavage (Caspi, 1997). Generally, manufacturers prefer sawable rough diamonds because they can be cut into two or more diamonds and result in relatively less weight loss during polishing. In contrast, makeable diamonds are polished as uncut diamonds but require more work to polish because their grain structure can be hard to determine and they result in a lower yield or weight retention after the manufacturing process (Klein, 2005). Cleavage diamonds are irregularly shaped diamonds and therefore require a lot more deliberation to determine how to best to process them (Klein, 2005). The pre-sorting of rough diamonds is important as it determines how each diamond can be processed.

### *Planning and Marking*

Once the diamonds have been sorted, the next stage is planning and marking which is an important stage as it determines how the rough diamonds should be cut if they are sawable and how they should be shaped afterwards in order to maximise the firm's profit. "This is crucial step because it represents *the major* decision on how to manufacture a given piece of diamond rough" (Caspi, 1997:106 – italics in original). The planner is therefore known as "the architect of the diamond" (NWT, 2002:34) and is usually the most experienced person in the factory, a specially trained employee or even a specialised subcontractor (Caspi, 1997:106). The existence of outsourced planning and marking shows that these skills are largely industry-specific. This is the most difficult stage in diamond manufacturing because no two rough diamonds are the same and each may have its own unique imperfections or flaws that need to be taken into account to produce the highest

value polished diamond or diamonds. The planner's task is to find a way to maximise the value of the polished diamond, which depends on the shape and proportions chosen by the planner. A rough diamond can produce a variety of polished diamonds with very different values (Caspi, 1997). It is therefore important that the planner chooses the polished diamonds that will produce the highest value for the firm.

The planner studies and designs each diamond using computerised equipment and specialised software. During the planning, a planner may ask a polisher to 'open a window' on the diamond which means polishing a facet (a flat polished surface) on the stone so that the internal colour and flaws (known as inclusions) can be inspected. The planner then writes the manufacturing plan for each diamond on a folded piece of paper known as a parcel that includes information on the stones expected yield, a diagram of its imperfections and the shape it will be polished into and so on. The diamond will be kept in this paper parcel and the planning information on it will be used in each department it goes through. All the processes it undergoes and the weight it loses during each one, will also be recorded on the parcel. Lastly, in the planning stage, the rough diamonds that are sawable are marked with ink to indicate where they will be cut in the next stage of manufacturing process.

### *Cutting*

Historically, diamonds were cut using the cleaving technique, which is the oldest form of diamond cutting that demanded great craftsmanship (Watermeyer, 1980). The rough diamond would be struck carefully along the grain with a sharp tool to split it into two or more pieces. Today, most diamonds are cut using either a blade sawing machine or laser technology. These techniques, unlike cleaving, enable the rough diamond to be cut against its grain. When using a sawing machine, the diamonds are set using special paste and fixed into a holder known as a dop and mounted on a sawing machine. The saw is a thin blade

coated with a mixture of oil and diamond powder that revolves to cut through the rough diamond. Sawing is a very slow process that can take days. In contrast, when using laser technology, a laser beam cuts the diamond by burning its way through the diamond much faster than a sawing machine. Laser sawing is two or three times faster than blade sawing (Klein, 2005). Since the capital costs of laser technology are considerably higher, the majority of factories use a combination of machine and laser sawing (Caspi, 1997 and fieldwork research).

### *Bruting*

After the diamonds are cut they undergo a process known as ‘bruting’ in order to smooth their sharp edges and give them their basic shape (Caspi, 1997:114). The bruting process also includes a process known as ‘girdling’ which creates a perfectly round band at the widest part of the diamond known as a ‘girdle’, where the top and the bottom of the diamond meet (see Figure 5.1). The ‘bruter’ needs to be very careful and ensure that the stone does not lose too much weight at this stage of the manufacturing, because excessive bruting can result in a significant weight loss when the diamond is polished in the next manufacturing process. The yield of a diamond is the difference between the weight of the rough diamond and that of the resulting polished diamond.

“Yield is affected by two factors: the diameter to which the diamond is cut, and the centre of symmetry around which the diamond is bruted. A minor mistake made in either of these factors because of excessive bruting can produce a significant loss of weight” (Caspi, 1997:115).

Bruting can be done either by using a traditional manually-operated bruting machine, an automated bruting machine, or with laser technology. With the bruting machines, the two diamonds are carefully fixed onto a dop so that they are centred; the diamonds are then put

into a spindle that rotates at a high speed and rubs them against each other so that they wear each other out. The bruter needs to stop and check the diamonds constantly to make sure that desired outcome is achieved. The automated bruting machine requires less supervision, with one person being able to operate a number of machines at the same time. The automated bruting machines can also have manual or automatic centring systems that use video cameras, to ensure that the diamonds are centred to maximise yield during the bruting process (Caspi, 1997:116). The automated centering systems rely on special computer software. Lastly, the laser bruting machines brute diamonds by burning off the edges of the diamonds with the laser beam, giving them their basic shape.

### *Polishing*

The last stage of the manufacturing process is polishing. This is the longest process and is where most of the workers in the factory are employed (as shall be discussed later in this chapter). Polishing gives the diamond its final shape by polishing the facets, which are flat polished surfaces or planes, onto the diamond. Polishing is also known as facetting, and polishing can also refer to the final process when, after facetting, the facets are smoothed. It may take several hours to polish one facet (Klein, 2005). For round brilliant cut polished diamonds (see Figure 5.1), firstly the table facet is polished, and then the main eight facets are polished on the top of the diamond (the crown) and the bottom of the diamond (the pavilion). This process is known as ‘crossworking’ or ‘blocking’. Next, the diamond’s girdle is polished. According to the firm’s preferences, it can be faceted or left smooth. Lastly, the diamond is perfected using very accurate polishing to give the diamond the rest of its facets. There are 16 facets on the pavilion, (called the bottom-half) and on the crown, (known as the top-half) and 16 star shaped-facets on the top of the crown. This is called ‘brilliantteering’. Polishing is a very precise job because the angles of the facets need to be proportional, symmetrical, and polished smoothly in order for the polished diamonds to absorb and reflect light properly. The ‘brillianteerer’ not only grinds down the facets like

the other polishers (for example the ‘blocker’ or ‘crossworker’) but also polishes or smooths the facets afterwards to ensure smooth polished facets on the finished diamond. These are crucial in determining the diamond’s value.

Diamonds can be polished manually or using automated machines. The diamonds are fixed to an arm-like tool known as a ‘tang’ and polished on a round flat disc, known as the ‘scaife’, which is coated with diamond dust and oil. The ‘tang’ allows the polisher to set the angle that is needed to polish each facet. Diamonds can only be polished in the direction of the grain orientation. Automated polishing machines are essentially robots that are controlled by a trained operator to polish up to 16 round cut diamonds simultaneously. This makes automatic machines significantly more productive than manual polishing (Caspi, 1997). The operator is still very important in automated bruting and is responsible for setting the angles for each diamond’s facets on the automated polishing machine and for monitoring the machine.

### *Quality Control*

Quality control is crucial throughout the manufacturing process because it ensures that each diamond is being polished according to the initial plan laid out by the planning department. This ensures that if a diamond’s processing deviates from the plan, this can be recognised and corrected during the manufacturing process and not at the end. Quality control also monitors the diamond’s weight loss. Quality control can take place after or during each process. The amount of quality control that takes place depends on each firm’s particular preference, which is influenced by the grade of polished diamonds that the firm manufactures. A diamond may be put through a particular stage more than once based on the quality controller’s recommendation.



### *Final Inspection*

When the processing of the diamonds has been completed they are boiled in hydrochloric acid and treated with ultrasound waves to clean them. The diamonds are then inspected to ensure that they meet the firm's manufacturing standards. If they are not up to standard, they can be returned to the relevant manufacturing process to rectify them.

### *Grading*

After the polished diamonds have passed their final inspection they are then graded to determine their value. Grading assesses the craftsmanship that went into manufacturing the polished diamond. Grading is crucial to the industry because it determines the value or price of a diamond and it reassures the customer of the quality of the polished diamond. The Gemmological Institute of America (GIA) introduced the International Diamond Grading System to the industry in the 1950s to provide an independent and standardised measure of craftsmanship, or "the care that went into the crafting of a polished diamond" (Gillen, Lanzl and Yantzer, 2005:80). The grading system consists of a standard measure of their carat, colour, clarity and cut, known as the 'Fours Cs' of a polished diamond.

Carat is a measure of weight with 1 carat equivalent to 0.2 grams. The heavier a polished diamond is, the more expensive it will be. On average, about 50 per cent of the rough diamond weight is lost during the manufacturing process. The diamond's ability to reflect light is also determined by its colour. Coloured diamonds are a very rare and expensive with 95 per cent of diamonds being colourless (Boonen and Heens, 2002:14). 'Colourless' diamonds can be yellowish due to the presence of nitrogen when they were formed, so their exact colour is determined by comparing them with test 'master stones'. Their colour is rated according to a colour grading scale, which ranges from 'exceptional white' to 'light yellow' or 'brown'. Colour grading can be a very subjective process. Since a slight increase in the colour grade can cause the value of a diamond to increase substantially, a

number of graders, either inside a firm or in a gemmological laboratory, can be consulted before a consensus is reached on the colour of the diamond.

The clarity of a polished diamond depends on the extent of its internal imperfections, such as scratches or cracks. Polished diamonds are examined under a microscope to determine all their imperfections. A diamond's clarity is then graded based on this examination. The clearer a diamond is found to be, the greater its value. The cut of the polished diamond is graded ranging from excellent to poor, according to its proportions, symmetry and the quality of its polish. The cut of a polished diamond affects its light performance, known as the 'display of brightness'. This is "the combination of white light reflecting from the surface and interior of the diamond" (Lanzl et al, 2006:2). The 'display of brightness' is determined by the diamond's 'fire', (which "describes the 'flares' of colour emitted from a diamond" when the light splits into a spectrum) (ibid), and 'scintillation', (which is "the flashes of light you see when the diamond, the light, or the observer moves") (ibid).

Cutting and polishing firms usually have workers who have been trained by the firm and by gemmological laboratories like the GIA. The GIA offers various levels of grading courses to give practical grading skills. The GIA and other gemmological labs also provide the firms with grading services. As part of these services, they award graded diamonds with certificates that state the grading of the diamond and many consumers further down the value chain only buy loose polished diamonds or diamond jewellery if it has a grading certificate.

The next section discusses the distribution of human resources in the cutting and polishing firms. This is done to shed some light on the relative importance of different employees' roles in the cutting and polishing firms.

### **5.3.The Distribution of Human Resources in Cutting and Polishing Firms**

Employment in the cutting and polishing firms is generally differentiated between production-related jobs and ancillary jobs. Production-related jobs are in turn differentiated on the basis of whether they are directly or indirectly related to production. According to a Human Resource Manager at one of the interviewed firms, direct production workers are directly involved in the processes used to cut and polish rough diamonds into polished diamonds and examples include sawyers, bruters, and polishers (Personal correspondence, March 2012). Indirect production workers are indirectly involved in production in that although they do not actively cut and polish diamonds, they perform tasks that ensure that the diamonds are cut and polished according to plan. Examples of these jobs are production managers, floor managers, planners and markers (Personal correspondence, March 2012). Ancillary workers are not involved in production in any way but instead support the main activity of cutting and polishing diamonds. Examples of these workers are general managers, human resource managers, and accountants (Personal correspondence, March 2012).

In comparison to non-production workers, employees in the production jobs are directly or indirectly involved in the manufacture of polished diamonds. The skills and knowledge requirements for the production and non-production related jobs vary, so it is important to understand the relative importance of production and non-production human resources in the firms before the skills requirements can be discussed.

A study conducted in India, the largest diamond manufacturer in the world, by the National Skill Development Corporation examined the human resource and skill requirements in the country's cutting and polishing industry (see Table 5.1). This study found that production jobs made up the majority of the employment in India's cutting and polishing industry,

accounting for 88 per cent of employment. Of the people employed in production jobs, 70 per cent of them were relatively lower paid, unskilled labour employed as polishers. The procurement of rough diamonds and the trading or sales of polished diamonds each only comprise 1 per cent of the labour force. Lastly, support functions such as administration and management are a tenth of the labour force in the industry.

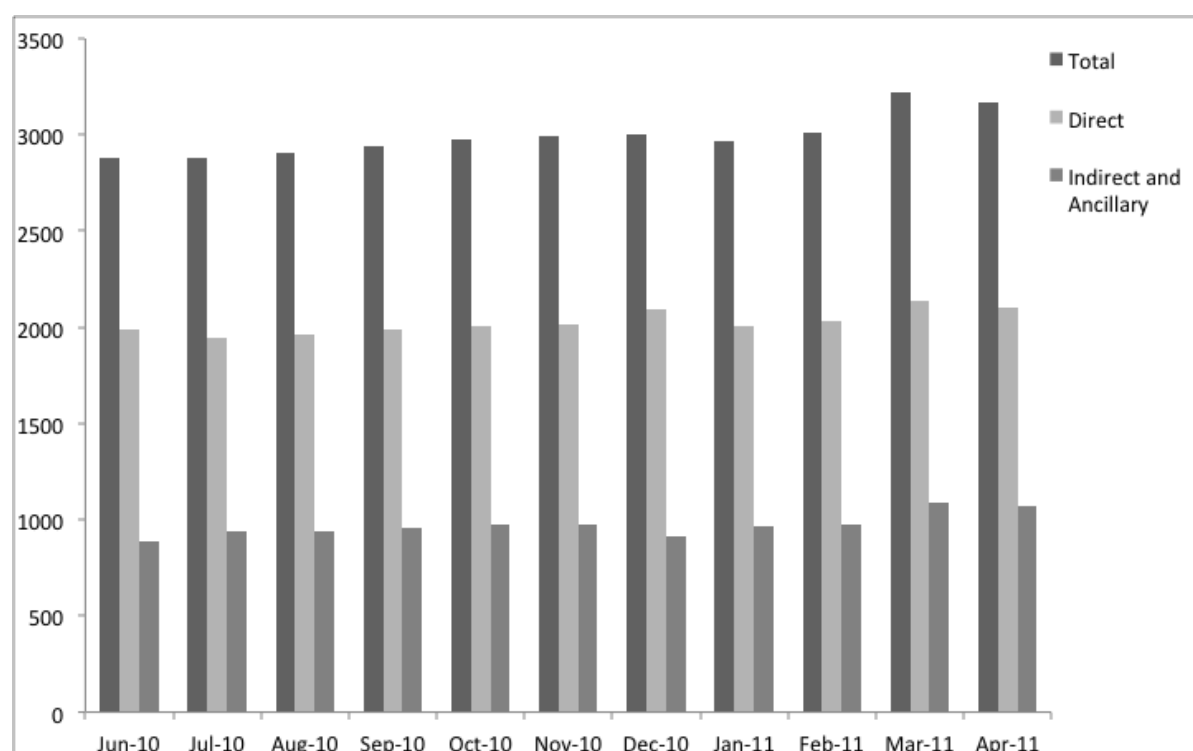
**Table 5.1: The distribution of human resources in India's cutting and polishing firms**

<i>Function</i>	<i>Distribution</i>
<b>Procurement</b>	<b>1%</b>
<b>Processing</b>	<b>88%</b>
- Planning of Cut	8%
- Cutting	5%
- Polishing	70%
- Grading	5%
<b>Trading/Sales</b>	<b>1%</b>
<b>HR, Administration, Finance, Senior Management, Other Support Functions</b>	<b>10%</b>

Source: NSDC (2010) data

Similarly, in Botswana the majority of workers employed in the cutting and polishing industry are also employed directly in production. To illustrate this, Figure 5.3 shows the workers employed in each of the 16 cutting and polishing firms that were operational between June 2010 and April 2011 according to whether they are involved directly in production or occupy indirect and ancillary jobs. This data was obtained from the government and it aggregates indirect and ancillary employment. According to this data, employment in the 16 cutting and polishing firms increased from 2,877 in June 2010 to 3,170 by the end of April 2011. From June 2010 to April 2011, between 66 to 69 per cent of the labour force was employed directly in production jobs.

**Figure 5.3: Employment breakdown in the 16 diamond cutting and polishing firms**



Source: data from Botswana Government, chart by author

In order to have some measure of the size of ancillary jobs compared to indirect jobs, Table 5.2 shows the breakdown of employees obtained from a firm during fieldwork research. This data differentiated between indirect and ancillary jobs. In this firm close to 73 per cent of employees were employed in direct production jobs whilst 13.4 per cent were involved in indirect jobs and 13.9 per cent were employed in ancillary jobs.

**Table 5.2: Breakdown of employees in a cutting and polishing firm**

<i>Type of Employment</i>	<i>Percentage of Overall Employment</i>
Direct	72.7%
Indirect	13.4%
Ancillary	13.9%

Source: fieldwork research

This data shows that the majority of workers in the cutting and polishing firms are employed either directly or indirectly in production jobs. Although ancillary are important for the efficient running of a factory, it is clearly the production-related skills that are most crucial for generating the rents earned by the firms for the skills, knowledge and capabilities possessed by their human resources. The largest proportion of jobs in the cutting and polishing industry are in production and any analysis of human capital development in this industry needs to have a key focus on the skills, capability and knowledge required in production related jobs. Thus the next sections will start by discussing the skills required in the different production jobs.

## **5.4.Human Capital Requirements for the Production Jobs**

The next three sections discuss the general, industry-specific and firm-specific human capital requirements in the cutting and polishing industry for employees that are involved directly in production.

### **5.4.1. General Human Capital Requirements**

This section discusses the general skills needed by all workers working in the production, irrespective of their particular role in the manufacturing process. According to Schultz (1993) general human capital can be divided into two categories: (1) innate qualities that are either part of their personal attributes like creativity and concentration, or are displayed by the workers' physical abilities like good eye sight and manual dexterity, and (2) human capital developed in the general education system like basic literacy and numeracy. According to Becker (1964) the firms are unlikely to train the workers in general human capital but may rather recruit workers who already possess this human capital. This general human capital will be part of the firms' job recruitment specifications and during recruitment workers will be examined to see if they are a good fit for the job based on these requirements. The education requirements for production jobs are not that high, with

workers needing only a basic level of education that can be acquired at the primary and secondary school level. The most important job requirement for diamond manufacturing jobs is for workers to have the right personality and characteristics for the job and for them to show the potential to learn the skills required. A manager at one of the cutting and polishing firms described this as the worker being “trainable” (Interview, Gaborone, May 2011).

#### **5.4.2. Industry-Specific Human Capital Requirements**

This section discusses the industry-specific skills and knowledge that the workers need for production jobs. This is the type of human capital that can increase productivity in all the firms in the industry. Industry-specific human capital can be divided into two categories: (1) industry-specific human capital that all workers employed in any of the production jobs need to possess, and (2) industry-specific human capital that is specific to the job that a worker does in the production process. The later type of human capital is industry specific because all the firms in the cutting and polishing industry generally use the same production processes and some of these function can also be outsourced to specialist firms in the industry.

All production workers in the industry need to have the skills, capabilities, and knowledge needed to work with diamonds or as Klein (2005:18) puts it:

“The highly specialised work of a diamond cutter and the coloured-stone facetter requires compliance with geometrical principles and the rules adapted to the refractive index that are characteristic of the gemstone being worked on. Some knowledge of the clearly defined science of crystallography, especially with regards to the planes of cleavage, careful consideration of the stone’s degree of

hardness, and a thorough acquaintance with the various forms of cutting are desired – no, they are required.”

In the DeBeers controlled segment of the global diamond industry, all production workers need to have knowledge of the Best Practice Policy (BPP), which is an industry policy used by all DeBeers’ Diamond Trading Company (DTC) customers to ensure that diamonds are polished using the industry’s best practice. The DTC Botswana is the distribution arm of DTC in Botswana. DTC’s BPP guides the manufactures’ corporate policies. All DTC Sightholders need to comply with BPP and, in Botswana, DTC Botswana audits the firms to check compliance. The Sightholders are DTC’s clients that get allocated rough diamonds that are sold ten times a year during “Sight” weeks. The manufacturers are assessed according to their business, social and environmental responsibilities. Their business responsibilities cover ethical standards, financial practices like money laundering, the Kimberley Process, the system of warranties, and supply chain management. Their social responsibilities cover employment, health and safety, disciplinary procedures, child labour, forced labour and other human rights. Lastly, their environmental responsibilities are based on international standards for best environmental practices and regulatory frameworks. The firms have designed their corporate policies around BPP as they have to complete the BPP workbook regularly and this workbook sets out the performance indicators against which compliance with the BPP will be evaluated, verified and reported to DTC. The companies face penalties if they fail to comply and this also constitutes a breach of the Sightholders’ obligations under the Supplier of Choice arrangement. It is therefore important that workers have knowledge of the BPP particularly workers in more senior positions who need to ensure that the firm complies.



### **5.4.3. Job-Specific Human Capital Requirements**

This section discusses the industry-specific human capital needed for the different production jobs. This type of human capital is specific to the job and general to the industry.

#### *Sawyers*

“A sawyer is responsible for bisecting a rough diamond, according to the marker’s specifications into two diamonds with flat smooth tables” (NWT, 2002a:1). There are two types of sawyers in a factory, those that work with blade machines and those that work with laser machines. The human capital required by a sawyer depends on the technology that they use. Sawing is a very precise job that needs experienced workers who are able to cut diamonds precisely where the marker has indicated. Laser sawing is much simpler than blade sawing and laser sawyers mainly need to be able to work with laser technology.

#### *Bruters*

“A bruter is responsible for creating the girdle of a round brilliant diamond with the maximum diameter using a manual, disc or automated method” (NWT, 2002b:1). Bruters can either be manual bruters or automated bruters. Unlike manual bruting, “the automatic system requires no expertise on the part of the operator” (Caspi, 1997:117). Thus the human capital requirements for manual bruters are higher than for automated bruters.

#### *Polishers*

Diamond polishers make up the majority of the labour force in the cutting and polishing industry. Polishers can be divided into ‘round brilliant cut polishers’ and ‘fancy cut polishers’. According to the NWT (2002c:1), the role of round brilliant polishers’ can be described as follows:

“Round brilliant diamond polishers are responsible for creating round brilliant shapes by polishing facets according to the company’s specifications and sequences. They may polish rough, sawn, cleaved, bruted or lasered diamonds. They may specialise in blocking, crossworking and/or brilliantteering.”

The principles behind polishing fancy diamonds are similar to those for round brilliant diamonds but workers need to be trained specifically for round or fancy cuts. Polishers can either be manual polishers or automated polishers specialising in polishing different types of facets. Polishing a facet onto a diamond requires a particular technique or a ‘light hand’ to ensure the process is done properly, or as explained by Bonke (2012:15):

“Diamond polishing is not an easy profession. The first requirement is what the experts call a ‘light hand’. Within the first weeks itself, we get to know which of the training candidates has a light hand and which has a heavy hand. A light hand implies fine motor skills together with a certain sensibility.”

A diamond polisher also needs to be very skilled to achieve the angles required to produce a high quality polished diamonds. As Klein (2005:89) contends “since similar facets must be of the same size and have the same angles, the polisher is required to have a fine sense of and feeling for proportion and symmetry”. In order to achieve this symmetry a polisher needs the certain balance, or as Bonke (2012:18) put it,

“A diamond polisher must have a balanced mind because without equanimity and inner peace, he/she will make mistakes. The smallest carelessness can mean the loss of an entire stone. If the diamond is set at the wrong angle and at a wrong speed, it can go into the iron girdling disk and break into many small pieces ” (Bonke, 2012:18).

Since diamonds can only be polished in the direction of grain, a polisher must also be able to identifying each diamond's grain. In other words, a polisher "must be able to identify the three crystal faces or their corresponding planes and then determine the polishing or faceting grain of any given area on the rough surface" (Watermeyer, 1980:18).

In a modern factory, polishers either specialise in crossworking or brilliantteering, and even within those roles a polisher may specialise further and only polish a specific facet onto the diamonds:

"To speed up the training program of apprentices and to stimulate production, the separation of faceting into two departments became necessary. This is now common in the chain system of manufacturing, where these departments are divided into lesser, and still lesser ones, where the polisher's job is limited to working only one type facet." (Klein, 2005:86).

A crossworker who is also known as a blocker is also know as a crossworker or a crosscutter and is responsible for polishing the first eight main facets on the crown and the first eight main facets on the pavilion, as well as the large table facet and the very small cutlet facet. According to Klein (2005:87),

"The blocker's work covers skilful handling of the stone for retaining weight and limiting inclusions, measuring angles, and making the basic shape. This is the platform for the make and the brilliance of the eventually completed stone."

Blockers are trained for longer "as the future value of the rough stone depends heavily on this department. This does not mean that other departments require less skill but only that

the blocker requires a greater field of knowledge and experience to apply to the stone”(Klein, 2005:90).

The brillianteerer polishes the remaining facets on to the diamonds and also smooths them to ensure that the polishing lines do not show on the diamonds surface. This stage of the manufacturing process is very important for determining the grading of the polished diamond. It requires a great deal of skill to ensure that the diamond is finished perfectly and receives a high grade. A lot of the skills used in this process are firm-specific, as each firm has its own production specifications that are often determined by its customers or its expertise. The other type of polishers are automated polishers who need to be able to operate the robot arms used to polished diamonds in automating polishing. These workers are not required to have manual polishing experience. Instead they need to know how to programme the machines and inspect the diamonds to ensure that they are being polishing properly. Automated workers also need to know how to multi-task, as they may operate several machines at a time.

The opening of windows can be done by a crossworker or brillianteerer. There is not much skill needed to polish these facets, the polisher simply needs to follow the marker’s mark indicating where the window should be polished (Watermayer, 1980:20).

Despite the significant industry-specific skills needed by production workers there is not a great deal of formal industry training taking place globally in diamond cutting and polishing centres (Jha and Tomar, 2007). Most of the training in the industry takes place in the firm (ibid). As Watermeyer (1980:3) argues “In most diamond centres of the world, there are virtually no facilities available, outside of a diamond cutting factory, for furthering the education or knowledge of those who wish to become specialist diamond cutters”. Although some industry training schools have been established in some diamond

cutting and polishing centres in recent years, the majority of training still takes place in the firm (this will be discussed further in Chapter 7).

#### **5.4.4. Firm-Specific Human Capital Requirements for Production Jobs**

This section discusses the firm specific human capital that is required in production jobs. This type of human capital is unique to the firm and can therefore only increase productivity in the training firm. Firm specific human capital is generally linked to a firm's routines and policies, or the procedures or habits of doing things in the firm. A firm's routines are determined by its different systems such as the information technology (IT) systems and its inventory control systems. A firm's IT systems are unique to the firm and can be developed in-house by the firm's IT department. The firm's IT systems link information through the factory so that management monitor the flow of information in the factory and flow of production in the factory. Management will be able use the IT system to determine where every diamond is and how far it has progressed in the production line. A firm's IT and inventory system reinforce its security system since workers deal with valuable diamonds and at any point the firm can see where every diamond is in the factory. This also enables the firm to monitor each worker's productivity and to identify and ease any bottlenecks in the production line. Most firms have IT systems that are linked to their parent company. This ensures that at any point the parent company can see the progress being made with production in all its factories to enable it to plan sales targets. The parent company sets production standards according to customer preferences and market conditions.

A firm's product specifications are unique to the firm since they are determined by its capabilities and customer preferences. In particular when a firm has customers that make large orders, these customers can also influence the cut of diamonds that the firm manufacturers. As Bonke (2012:21) argues,

“Big customers not only try to control the quality and quantity in exactly defined volumes, but often also the type of cut. For example, in the USA, there is a demand for brilliants with very fine table facets and high crowns, or the so-called ideal cut. Tension ring manufacturers want faceted girdles; wedding ring manufacturers prefer flat brilliants and watch manufactures determine exact tolerances from crown angles”

The last stage of polishing, ‘brillianting’, is done according to a companies cut specifications and company policies. For example, the firm’s faceting sequence (the order in which the facets get polished) and the number of facets on the finished diamonds can be unique to the firm. For example, some firms have diamond cuts that have been developed by the firms and are patented by the firm.

The notations used on the parcel papers (in which rough diamonds are enclosed) can be seen as the ‘language of the factory’ as they are used to communicate the production plan for each diamond as it goes along the production line. Although there are general notations used in the industry, each firm can also adapt these notations. The parameters used in the different processes are also firm-specific. For example, the parameters for grading criteria vary among processing plants and countries (NWT, 2002).

Lastly, although a company’s policies are guided by the DTC’s BPP, the firms still have their own company policies, such as their human resource policy and health and safety policy. All production workers need to have an awareness and understanding of, and be compliant with the firm’s policies.

## **5.5.Human Capital Requirement for Non-Production Jobs**

This section discusses the skills and knowledge required in the non-production related jobs in the cutting and polishing factories. As discussed earlier in this chapter, non-production jobs fall under either indirect jobs or ancillary jobs. Indirect jobs are for workers who are indirectly involved in production, whilst ancillary jobs are for workers who in the general administration of the factory. This section starts by discussing the general human capital that all workers in non-production jobs need to possess. This is followed by the industry and firm specific human capital requirements for all different indirect and ancillary jobs.

### **5.5.1. General Human Capital for all Non-Production Jobs**

This section discusses the general human capital needed by all workers in non-production jobs in the cutting and polishing factory. All workers need to have a basic education and the right personal attributes to work in the firm. These requirements may not differ greatly from what firms in other industries would require of its workers in terms of basic general human capital. However, some workers will also need to have the particular forms of general human capital such as higher education and training qualifications, for their jobs and further firm training. This is discussed next.

### **5.5.2. Indirect Production Workers**

Unlike the ancillary workers, indirect production worker need to possess technical human capital around production. For example, the production manager needs to have considerable production experience and a thorough understanding of all the production processes. The next section discusses the human capital needed by indirect workers in more detail.

### *Production Manager*

The production manager is a “specialist and a key man in diamond processing” (Watermeyer, 1980:3) who is in charge of production and has to ensure the smooth running of production in the firm so the firm reaches its production targets. Although the production manager needs some management skills as he has to manage all the workers in production, he first and foremost needs to have technical production skills. As a manager at a firm explained, “A production manager is 10 per cent management skills and 90 per cent production skills” (Interview, Gaborone, May 2011). Or as described by Watermeyer (1980:3), “He must never be relegated to a charge-hand or checker as his knowledge on diamond faceting and human relationships must be unlimited”.

The production manager has to have the ability to manage the flow of production. He needs to be able to identify and ease any bottlenecks by either moving workers to other departments temporarily or hiring and training new workers. He also has to design the factory floor so that it maximises the factory’s productivity. The design of the factory is not only about the layout of machinery and equipment but also about how people are utilised throughout the production process. The production manager has to make sure that workers are working in the department that they are most productive in, so during training it is important for him to identify the worker’s best skills in the production process. He also has to pair workers with supervisors who are a good match and can work well with each other to maximise productivity. He also has to make sure that workers are placed in such a way that reduces conflict or distractions amongst them so that they can be at their most productive. One of the managers called this “synergy” between workers on the one hand and between the workers and supervisors on the other hand (Interview, Gaborone, May 2011). The production manager also needs to have knowledge of the firm’s policies, such as its conflict resolution procedures so that he can address any concerns or queries workers



may have. He also needs to be able to take decisions in the factory, for example, about how best to fix damaged stones.

### *Floor Managers or Supervisors*

The factory has a floor manager in every department who is responsible for monitoring the flow of production in each department to maximise its production. The floor managers work closely with the production managers. The floor manager needs to be an experienced expert as he is responsible for training new workers in the department. He needs to help the production manager to identify the production workers' best skills in the various production departments during training. The floor manager also plays an important role in conflict resolution and in addressing the workers' technical queries.

### *Rough Diamond Procurers*

The first stage towards processing diamonds is procuring or buying them. Diamonds are procured either through the long-term sales contracts like the one the Sightholders have with DeBeers or on the open market. The firms purchase rough diamonds based on their technical, distributional and financial capabilities. A firm's technical capabilities or their ability to manufacture certain types (cuts, sizes etc.) of polished diamonds depends on their human resources and technological resources. A firm's distributional capabilities depend on their customers and the types of polished diamonds demanded by them. In vertically integrated firms, like those operating in Botswana, their distributional capability depends on the nature of their target markets. Their financial abilities depend on their parent companies and their access to finance from financial institutions.

The rough diamond procurers need to be aware of market dynamics such as consumer trends and pricing movements for the different categories of diamonds. The rough diamond procurers also need to have a thorough understanding of the crystallography or gemmology

of diamonds in order to check diamonds under a loupe (special magnifying glass used to examine diamonds) to determine their flaws, assess how this would affect their prices and decide if the firm has the capabilities to process them. This is a very skilled job as it determines if the firm will be profitable based on its rough diamond purchases and the kind of polished diamonds it can make from them.

### *Rough Diamond Sorters*

The rough diamond sorters are responsible for sorting the rough diamonds in preparation for production. The rough sorters must be able to sort diamonds according to the different categories used in the firms. In order to sort the rough diamonds, the rough diamond sorters need to have an understanding of the gemmology or crystallography of rough diamonds to enable them to sort diamonds between the different categories such as makeable and sawable rough diamonds. These are the categories that determine how the diamonds will be processed in the later stages of the manufacturing process.

### *Planners and Markers*

The planner is the architect of the diamonds and is usually the most experienced person in the factory who has a very good understanding of diamond processing and how to maximise the yield of the diamond (Jha and Tomar, 2007). According to Watermeyer (1980:14), “It is essential that the marker [planner] is well schooled in the economics of diamonds which not only covers optimum weight recovery but also the most economic sizes, purity, possible changing of colour and then the shape”. The planners have to have a good knowledge of the gemmology or crystallography of diamonds so that they are able to decide the most economic way of processing each diamond in order to maximise the firm’s profits. The planning department uses a variety of sophisticated machinery, equipment and technology, such as Computer-Assisted Design (CAD) t so these workers need to have computer skills and they also need to be able to use the particular software used in this

department. The technology in diamond planning changes rapidly so the workers in this department need to be able to adapt to new technologies.

### *Quality Checkers*

Quality checkers are crucial throughout the manufacturing process because they ensure that each diamond is being polished according to the initial plan laid out by the planning department. They ensure that if diamond processing deviates from the plan this can be realised and corrected as it arises. The quality checkers need to be trained in every department so that they have some production experience. This is because they need to understand the different roles and functions of the various departments, so that they know where to send a diamond for further processing once they have inspected it. The quality controllers need to be able to use all the different equipment and software programmes that are utilised to inspect and analyse diamonds.

### *Polished Diamond Graders*

The polished diamond graders are responsible for grading the polished diamonds once they have undergone final inspection. Grading is very important because it determines a firm's pricing of their finished product. Each diamond is different and needs to be graded separately so the graders need to gain experience by grading a large number of diamonds. To grade diamonds they need to have a thorough understanding of the GIA's International Grading System which includes a technical understanding of the Four Cs used to grade diamonds and the GIA's latest developments in grading. The graders also need to be able to differentiate between synthetic and natural diamonds. This skill is important since synthetic diamonds are playing an increasing role in the diamond industry (Even-Zohar, 2007). The firms usually take experienced workers to the GIA or other gemmological laboratories to get professional grading qualifications. The firms tend to invest relatively

more in the graders than in other workers in the factory since they can get professional qualifications and their role is especially important for pricing.

### *Maintenance Workers*

The firms also have maintenance workshops that are in charge of maintaining and repairing some of the equipment used in production. The skills needed by the maintenance workshop depends on they type of maintenance that the firm does and what it is able to outsource to other firms. Maintenance is not part of the firms core business but if there is a lack of providers for these services, the firm may do some maintenance functions in-house. The maintenance workers need to have the relevant technical skills to maintain and repair the machinery and equipment that is used in the firm. For example, these workers may need a professional electrical qualification to work with electrical equipment. A firm would then train a worker to be able to work with the machinery and equipment used in the firm. Since specialist machinery and equipment companies supply all the firms in the industry, the skills acquired in the firm may be useful to other firms in the industry. The maintenance workers also need to adhere to safety instructions when working with hazardous materials. The workers also have to adhere to their firm's preference on maintenance such as knowing what is done in-house, what is outsourced, how the maintenance is carried out and how often it is done.

### *Interpreters*

Due to language barriers in some of the firms, a firm may have interpreters to facilitate communication in the factory. Although the interpreters do not need to have production training they need to be able to translate between the relevant languages in the factory and this will include the translation of industry terms and concepts, so a basic understanding of the production process is useful for the interpreters.

The next section discusses the human capital requirements for workers in ancillary jobs

### **5.5.3. Ancillary Jobs**

Ancillary jobs are support jobs that assist with the general administration of the factory (Interview, Email, March 2012). These workers include the general manager, accountants, human resource manager, and personnel staff. These workers do not need to have any technical production skills or knowledge. So their human capital can be used in any industry, for example a human resource manager would play a similar role in any organisation regardless of the industry. This section will focus on the key ancillary jobs.

#### *General Manager*

The general manager is responsible for the overall running of the firm. The general manager does not need to possess technical knowledge and instead has to have the management skills to run a profitable business. As a technical director at one of the firms explained, the ‘top management’ could come from any industry because it just needs to understand entrepreneurship” (Interview, Gaborone, May 2011). The general manager also needs professional or higher education qualifications and management experience.

#### *Stock Managers and Controllers*

The stock controllers and managers are responsible for managing stock levels in the factory. It is very important that stock levels are maintained because the lack of some materials used in the production line can cause production to stop in one part of the chain that will eventually lead to stoppages further down the production line. The stock managers need to monitor the inventory control system to record stock levels and demands for different supplies. They also need to place orders to maintain stock levels so that at all times the production workers have all the supplies they need to keep working.

### *Other Administrative Staff*

Other administrative staff in the cutting and polishing factory include accountants, human resources managers, logistics managers, housekeeping staff like cleaners and cooks, the security team and personnel workers. In terms of general human capital, these workers need to have relevant professional education, training and/or experience. For example, an accountant would need a higher education qualification in accountancy. A firm would then train these workers in its particular processes, procedures and systems. Skills needed by ancillary workers are mainly general or firm-specific, relative to industry-specific because these workers do not need the technical expertise and knowledge that is industry-specific. The jobs they do, such as accountancy, can be done without industry specific production expertise and thus their human capital can be used in a range of industries.

## **5.6. Conclusion**

This chapter discussed the general, industry-specific and firm-specific skill requirements in the diamond cutting and polishing industry for production workers, indirect production workers and ancillary workers. The production workers make up the majority of workers in the firm and their human capital is a key determinant of a firm's human resource rents. Thus it can be expected that a firm's training efforts will be largely focused on these workers. The production skills are developed over time with workers becoming more skilled as they gain more experience, so labour turnover is crucial to determining the level of skills developed by the firm. The indirect workers play a role in supporting the production workers, by either preparing diamonds for the production line or ensuring that production workers have all the inputs that they need to keep working. Although these workers do not work directly in production, their human capital requirements do consist of some technical production skills and knowledge. The level of skills required by workers in the cutting and polishing firms varies according to the type of work they do directly or indirectly in the production process, as Szenberg (1973:130) explains,

“The predominant proportion of the diamond labour force is found at the lowest level at which workers engage in specialised tasks, cementing and diamond faceting. At the other extreme are craftsmen versed in diamond gemmology, and foremen knowledgeable in supervising the various operations within the divisions of the plant. At the highest level of management, one finds the owner-manager competent in coordinating the activities of the whole diamond plant. It takes about two years for the skills concentrated at the lower level of the spectrum to be acquired, which, relatively speaking, is a rather lengthy period. For managerial talents to be acquired, they usually take longer periods.”

Lastly, the ancillary workers play an administrative role in the factory. These workers do not need to have technical production skills and knowledge, instead they need the relevant education, training and or experience. This chapter has provided an understanding of the firms’ human capital requirements. The following three chapters will investigate how these human capital needs are met by the education system, industry training institutes and the firms themselves.

## **Chapter 6**

# **Human Capital Formation in Botswana's Education and Vocational Training System**

### **6. Introduction**

This is the first of three chapters investigating the formation of human capital required by the diamond cutting and polishing industry in Botswana. This chapter explores the extent to which human capital formation takes place in Botswana's education and vocational training system to create the type of human capital demanded by the cutting and polishing firms. According to the analytical framework for human capital formation developed in Chapter 4, the education and vocational training system provides for general types of human capital that are useful to many firms. This makes investments in human capital in the education and vocational training system an important source of human capital in an economy with the World Bank (2002:1) stating that:

“A quality education, beginning with primary education, is fundamental to endow individuals with the capacity to successfully pursue their private goals, while at the same time equipping them with the knowledge and skills, as well as the values and attitudes, necessary to contribute effectively to the economic, social and political development of their societies.”

As we saw in Chapter 4, general human capital, such as basic literacy and numeracy, is developed most efficiently in a country's schooling system. This type of human capital Becker (1964) defines as general since it can raise productivity in many firms across many sectors. For example, accountancy qualifications acquired in universities or specialised accountancy colleges and technical electrical qualifications acquired in the vocational



training system can raise productivity in many firms, with these skills being more useful in some industries. Thus it is important to assess the ability of the education and vocational training system to meet the general human capital needs of the diamond cutting and polishing industry.

In order to identify the general human capital demanded from the education and vocational training system by the cutting and polishing firms, the first section of this chapter uses primary data obtained from three firms to investigate the general education and training attainment of their existing labour forces. The chapter then provides an overview of Botswana's education system and what its outcomes are in terms of human capital formation in the country. This is followed by a description of the structure, coverage and quality of Botswana's education and vocational training system looking particularly at: (1) the role of the government in the provision and funding of education and vocational training; (2) the coverage of the education system based on enrolment ratios; and (3) the quality of the education and vocational training system looking at pass rates and graduation levels.

As we saw in Chapter 4, the government needs to play an important role in the provision of basic and advanced levels of education since human capital is an important driver of economic growth and social mobility. As Doyle (1994:225) states, "The education of the public should be a responsibility of the public". The World Bank (2002) recommends that public financing should account for around 80 per cent of the country's total education expenditure. However, as discussed in Chapter 4, the role of the private sector in the provision of industry training, particularly in the vocational training system should not be underestimated as it can play an important role in the efficient provision of technical skills.

The last section summarises the chapter's findings on the ability of Botswana's education and vocational training system to meet the key needs of the diamond cutting and polishing industry.

## **6.1. Education and Training Attainment in the Industry's Labour Force**

This section investigates the level of education and training in the cutting and polishing industry's labour force. It uses primary data on educational and training attainment in the labour forces of three of the cutting and polishing firms. All the firms that were interviewed were asked to provide this data but only three responded to the request. Two of the firms that provided data collected it from their employees in response to my request, while the third firm provided estimates. Firm A asked its administration and factory workers (in general, factory workers represent 70 per cent of the labour force) to state their highest education and training attainment, whilst Firm B requested all its employees to state their highest education attainment and Firm C provided rough estimates for all its workers. Table 6.1 shows the data obtained on education and training attainment in the three firms' labour forces.

Botswana's education system consists of 7 years of primary schooling, 3 years of junior secondary schooling and 2 years of senior secondary schooling, this is known as a 7-3-2 education system. The tertiary education system awards various qualifications, which include certificates, diplomas and degrees, masters or doctorates. The vocational training system awards certificates for different trades, these are discussed in more detail in Section 6.4.3. The workers were asked to state their highest level of tertiary education, so if a worker had a degree and a certificate, their highest tertiary qualification was a degree.

**Table 6.1: Education and training attainment in three firms (%)**

	<i>Firm A</i>	<i>Firm B</i>	<i>Firm C</i>
<b>Percentage with secondary education</b>	100	98.3	98
- Junior Secondary	36.4	18	-
- Senior Secondary	63.6	80.3	-
<b>Percentage with tertiary education</b>	67.5	50	10
- Percentage with a certificate	31.2	-	-
- Percentage with a diploma	29.9	-	-
- Percentage with a university degree or higher	6.5	-	-

Data: Fieldwork Research

Table 6.2 shows a list of the qualifications issued by the different tertiary institutes in Botswana, which will be discussed in more detail in Section 6.3.3. One is required to have a minimum of senior secondary schooling for admittance into the higher education system. Workers in these firms could have obtained certificates, diplomas or degrees in various disciplines in specialised colleges or from universities, such as the Botswana Accountancy College, the National Institute of Information Technology or the University of Botswana. However, it is not possible to determine exactly where workers obtained their tertiary qualifications from since the data obtained from the firms did not have this information.

**Table 6.2: Qualifications issued in the tertiary education institutions**

<i>Public Institutions</i>	<i>Academic Qualifications</i>
Botswana Accountancy College	Certificates, diplomas and professional accounting courses e.g. CIMA, AAT, ACCA
Botswana College of Agriculture	Certificates, diplomas and degrees in agriculture
Francistown Teachers' College	Certificates and diplomas in primary school teaching
Lobatse Teachers' College	Certificates and diplomas in primary school teaching
Serowe Teachers' College	Certificates and diplomas in primary school teaching
Tlokweng Teachers' College	Certificates and diplomas in primary school teaching
Molepolole Teachers' College	Diplomas in secondary school teaching
Tonota College of Education	Diplomas in secondary school teaching
Institutes of Health Sciences	Five institutes offering diplomas in nursing

University of Botswana	Certificates, diplomas and degrees
<i>Private Institutions</i>	<i>Academic Qualifications</i>
Academy of Business Management	Certificates, diplomas and degrees
Ba Isago University College	University of South Africa degrees, diplomas and certificates
Limkokwing University of Arts and Technology	Foundation, Diploma, Degree and Masters, Professional Courses in Design, Multimedia, Communication, Media, Information Technology, Business Management and Architecture
National Institute of Information Technology	Certificates, Diplomas & Degrees in Information Technology

Source: Bailey, Cloete & Pillay, 2010

From Table 6.1 we can see that the overwhelming majority of workers in the three firms have acquired some level of education. Furthermore, the majority of the workers in all of the firms have some secondary schooling (junior or secondary schooling), with the biggest proportion of these workers in Firm A and B having completed senior secondary schooling. For example, in Firm B, 80.3 per cent of the workers had received senior secondary schooling having sat the Botswana General Secondary Certificate Examination (BGSCE), written at the end of secondary schooling. However, according to the manager of this firm, 85 per cent of these workers had failed this exam but despite the high failure rate, half of those that had written the BGSCE went on to acquire a tertiary qualification (Personal Communication, 19<sup>th</sup> June 2012).

Only Firm A provided a breakdown of the type of tertiary education its workers had obtained. This shows that of the two thirds of workers who had any tertiary education, most had either obtained a certificate or a diploma, with only 7 per cent having obtained a degree or higher. In Firm C, by contrast, an even smaller proportion of labour force (10 per cent) had received any tertiary education.

While there is some variation in education and training attainment in the three firms, which may suggest different recruitment strategies (see Chapter 8), in general, the labour forces in the firms have human capital obtained largely in the secondary schooling system.

Whether this reflects what the firms demand or what is actually available is a key question that will be addressed in Chapter 8. What is clear from this data is that the cutting and polishing firms do make use of human capital formed in the education and vocational training system. It is therefore important to understand how this general human capital is formed in system. The rest of this chapter investigates investments into human capital in the education and vocational training system, as well as the coverage and outcomes of the system. Chapter 4 showed that investments in human capital through formal education are an important source of human capital formation in any country. Thus it is important to understand how Botswana's education and vocational training system is financed, particularly the role of public financing in the system.

## **6.2. The Financing of the Education and Vocational Training System**

At independence in 1966, Botswana had very limited human capital, being amongst the 25 poorest and least developed countries in the world (Presidential Task Force, 1997:13). The colonial government had not made significant human capital investments. The limited school provision that existed at independence in 1966 was largely as a result of missionary initiatives. Indeed, the origins of formal schooling in Botswana go back to the middle of the 19<sup>th</sup> century when David Livingstone started his missionary work in Botswana. By the beginning of the 20<sup>th</sup> century, his and other missionary activities had resulted in twenty primary schools with an enrolment of about 1000 pupils (Colclough and McCarthy, 1980:205). It was also missionary initiatives that introduced secondary schooling to Botswana in 1944 and, at independence, the country had eight secondary schools of which only four offered the fourth and fifth year of secondary school (Colclough and McCarthy, 1980:207-209). Apart from two small teacher training colleges and a government training centre, no other secondary or tertiary education or formal training was provided publicly prior to independence (Colclough and McCarthy, 1980:208). It is therefore not surprising that at independence the country had a very limited population of formally educated people

consisting of only 40 university graduates who had studied outside the country, mainly in South Africa, and about 100 people who had acquired secondary school education (Siphambe, 1999:293).

After independence, the country had to rely heavily on costly imported skills in order to overcome the development constraint caused by the lack of local skills and expertise. This resulted in the majority of skilled jobs in government after independence being held by expatriates. For example, two years before independence, Colclough and McCarthy (1980:209) found that locals held only 24 out of 184 administrative jobs in the Protectorate Government, which were jobs that required university degrees. Even for less skilled jobs that required five years of secondary schooling, which included technical, executive and secretarial jobs, locals held only 275 out of 613 posts. By independence, expatriates held only one third of all government jobs. Six years after independence, expatriate employment in the formal sector, mostly for skilled workers, was 65 per cent higher than two years before independence and a further 13 per cent of skilled posts were reported to be vacant (Colclough and McCarthy, 1980:209). The schooling system that had inadequately provided for the staffing requirements of the pre-independence government could not meet the needs of the country after independence.

Due to the lack of skilled workers and the increased demand for skilled workers in government and the formal sector, the government made primary, secondary and university education the dominant concern of the education sector after independence (Colclough and McCarthy, 1980:211). The discovery and exploitation of diamonds that followed independence (discussed in Chapter 2) provided much-needed revenue that enabled the government to play a major role in the provision of education and training. As a result of this political will, significant progress was made in improving the education and vocational

training system in the four decades that followed independence.

The government has become a crucial source of financing for the education sector and in the decades that followed independence it became the main provider of education financing. In 1977, the first National Policy on Education was introduced. This policy aimed to increase access to education, particularly primary education, with the universal attainment of primary education becoming a national goal. To this end, in 1978, the government abolished school fees for primary schooling in government-aided schools and in 1989 did the same for secondary schooling. This led to significant increases in primary and secondary school enrolment (discussed in Section 6.2.3). Furthermore, in 1966, the World Food Programme introduced school feeding schemes in government-aided schools to ensure that students received free breakfast and lunch on every school day – this was to reduce the widespread malnutrition in the then very poor country - and by 1997 the government had taken over the funding the school feeding programme (BIDPA, 2011). School feeding programmes “alleviate short-term hunger, increase attention span, facilitate learning, and obviate the need for children to leave the school to find food. In-school meals also act as an incentive to increase school access” (Bundy et al, 2009: 30).

Botswana’s aspirations for the education system are stated in the country’s Vision 2016, which is a document that sets out the 7 pillars of the country’s long-term planning. The first pillar of Vision 2016 states that:

“By the year 2016, Botswana will have a system of quality education that is able to adapt to the changing needs of the country as the world around us changes. Improvements in the relevance, the quality, and the access to education lie at the core of the Vision for the future. The education system will

empower citizens to become the best producers of goods and services. It will produce entrepreneurs who will create employment through the establishment of new enterprises. Public education will be used to raise awareness of life skills, such as self health care” (Government of Botswana, 1997: 5).

This vision is consistent with other development policies like the current tenth National Development Plan (NDP 10) and the National Policy on Vocational Education and Training, as well international agreements like the global Millennium Development Goals (MDGs). NDP 10 gives an overview of the national educational policy framework including projects to be implemented within this plan period (2010 to 2016) to improve the quality of education in Botswana. In line with this and other goals set out in Vision 2016, all Government Departments, including the Ministry of Education and Skills Development as well as other organisations, have defined their own vision, mission and goals. With just five years until 2016, the chapter makes use of enrolment ratios and pass rates to assess the progress that has been made towards achieving “an educated and informed nation” (Government of Botswana, 1997: 5).

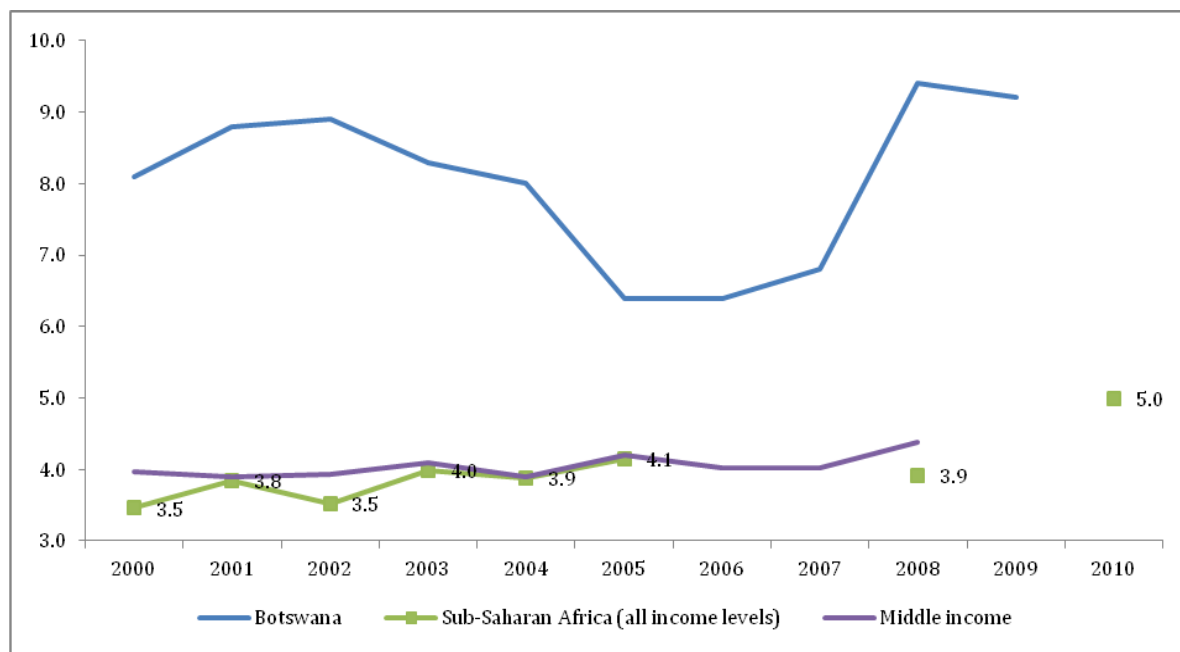
### **6.2.1. Government Expenditure on Education and Vocational Training**

Today, education is the Botswana government’s single largest expenditure. Public expenditure on education includes current and capital spending on both private and public education institutions at all levels of the education system, as well as government expenditure on subsidies for students and households for education. The government’s investments in education have made access to education more equitable, alleviating the financial constraints faced by individuals by subsidising the supply of education (through public schools) and the demand for education by subsidising households.



Figure 6.1 shows government expenditure on education as a share of gross domestic product (GDP) in Botswana in comparison to the Sub-Saharan Africa region and other middle-income countries.

**Figure 6.1: Government expenditure on education as a share of GDP**



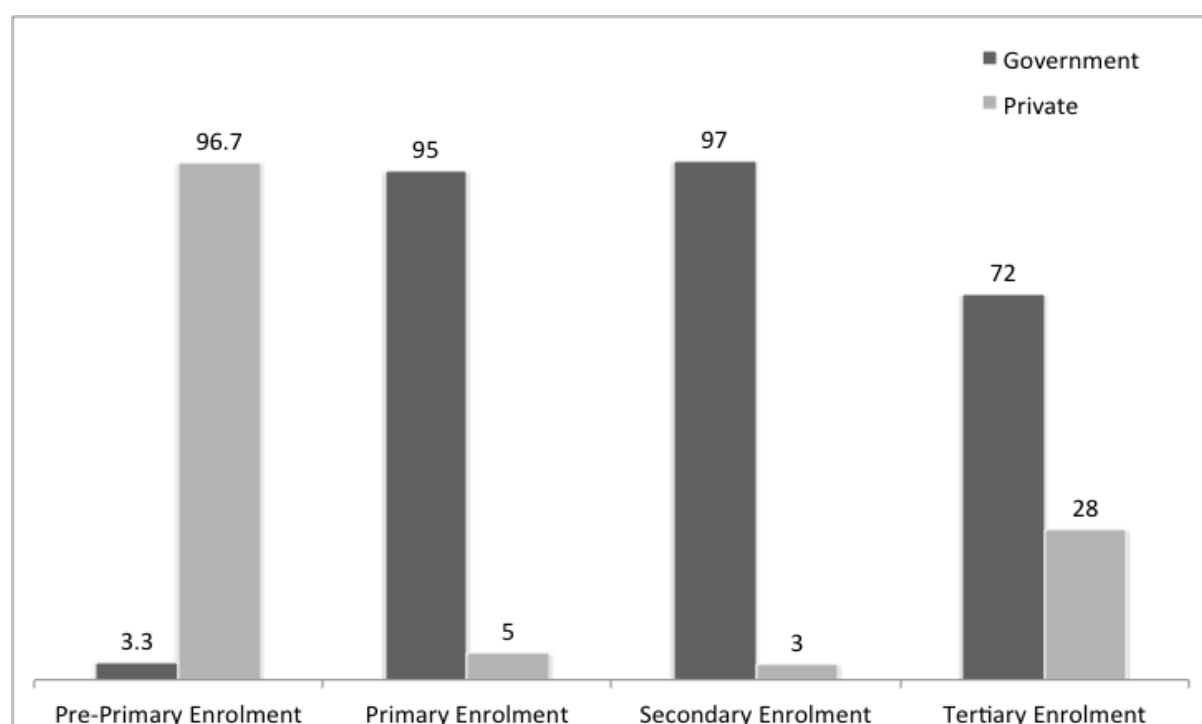
Source: Sub-Saharan Africa (which after 2005 was only available for the years 2008 and 2010) and middle income data from the World Bank database. Botswana data from Central Statistics Office, chart by author

For the decade between 2000 and 2010, Botswana's education expenditure was between 6 and 9 per cent of GDP. This is notably higher than the Sub-Saharan African average, which was between 3 and 5 per cent of GDP in the same period. Botswana's education expenditure is impressive even when compared to that of other middle-income countries, which was around 4 per cent over the same period. In the last decade, Botswana's government spent between 22 and 25 per cent of public spending on education. This is impressive considering government expenditure on education in the late 1960s, was only 10 per cent of recurrent budget. Furthermore, government expenditure on education has remained over 20 per cent since the late 1970s (Colclough and McCarthy, 1980:212). Consequently, Botswana's level of education spending has been recognised as one of the

highest by international comparisons (Molutsi, 2008:136). According to UNESCO data, high-income countries on average only spent around 12 per cent on education as a share of GDP in 2008. Botswana's investments in human capital formation through the education and training system are clearly impressive. But it is necessary to explore how these investments are made and what their outcomes are in order to understand whether human capital formation in the education and vocational training system meets the needs of diamond cutting and polishing firms. Thus the provision, coverage (or enrolment) and outcomes of the system are investigated in the rest of this section.

Along with financing education, government is the biggest provider of education, in terms of the numbers enrolled at primary, secondary and tertiary school levels, whilst the private sector is the biggest provider of education only at the pre-primary level (see Figure 6.2).

**Figure 6.2: Enrolment into private and public education providers (2007/8)**



Source: UNESCO Statistics, chart by author

In 2007, over 90 per cent of primary school students and secondary school students were enrolled in public schools. At the tertiary level, the private sector played a relatively bigger role in the provision of education with only about 70 per cent of students enrolled in publically-owned tertiary institutions. In contrast, the government plays a very small role in the provision of pre-primary school education with close to ninety-seven per cents of students enrolled in private institutions. Thus, apart from pre-primary education, the government plays a key role in not just the funding, but also in the delivery of education.

However, the government level of expenditure on education is taking constraints. As discussed in Chapter 2, the government is experiencing decreasing mineral revenues mainly as a result of the global recession. The government is expecting this trend to continue due to maturing diamond mines that are expected to reach depletion in the next two decades. Moreover, in the last decade, decreasing revenues together with the rising costs of education and the increasing demands on government expenditure in other sectors have combined to force government to decrease its expenditure on education. As a result, in 2006, the government reintroduced secondary school fees after over two decades of free basic education. The fees are heavily subsidised and are currently set at \$36 per year for the first three years of secondary school. Furthermore, they are means-tested to ensure that those who cannot afford to pay the fees still have access to secondary education.

A similar trend has also occurred around tertiary education. The government spends a considerable amount of the education expenditure on tertiary education, about thirty-two per cent of the overall education expenditure. In 1973, the government increased access to tertiary education by starting to grant students who qualify for tertiary entrance with bursaries to be repaid after the student graduates and finds a job. The repayment was five per cent of their initial gross salary for a number of years equivalent to the duration of study for which the bursary was awarded. These bursaries were awarded for study in both

local and international institutions. However, poor coordination between government and employers resulted in the majority of graduates not paying back their bursaries (Government of Botswana, 1991). So, in 1995, the government reformed the tertiary education funding system in order to improve cost recovery and to give incentive for skills development in priority sectors.

In the new scheme qualifying students are given a variable combination of a grant and a loan based on the human resource needs of the economy, in which the grant does not have to be paid back while the loan does. For students to qualify for state support they need a minimum level of points based on their final secondary school exam results. The Ministry of Education and Skills Development stipulates the point cut-off level and it can vary from year to year. The new and the old funding systems run concurrently until all the costs from the previous bursary scheme have been recovered. And like the old system, the new funding system covers study in either local or international institutions depending on local capacity and academic merit. The Ministry of Education and Skills Development is responsible for awarding these grants, which can be either direct sponsorships that are wholly funded by the government, or donor agency scholarships that may be partly or fully funded by an organisation or another country. Examples of the latter include Commonwealth Scholarships, Southern African Development Community (SADC) scholarships and scholarships provided by the Chinese government.

The Ministry of Education and Skills Development sorts areas of study into five categories based on the country's human resource needs (see Table 6.3 for the categories). The system then aims to address supply gaps in different sectors by channelling students into careers in these sectors. The relative amount of loan to grant that the student receives depends on how critical the lack of skills is in their sector of study. The courses that have been written in bold in Table 6.3 are those that were identified in Chapter 5 as being

particularity required by the diamond cutting and polishing firms, mainly in non-production jobs. Although some courses, such as those for schoolteachers, have not been written in bold, in an indirect way they do improve the quality of human capital produced by the system and would benefit the industry but in a more indirect manner.

**Table 6.3: Tertiary education Grant Loan System (GLS) categories**

<i>Category</i>	<i>Criteria</i>	<i>Examples of Courses</i>	<i>Grant/Loan</i>
1	Areas of critical human resource shortage	Medicine, Veterinary Medicine, Dentistry, Computer Science, Engineering, Architecture, Land Surveying, <b>Professional Accounting</b> , System Analysis, Actuarial Studies, Metallurgy, Mineralogy, Science and Setswana Teachers, <b>Technical Instructors</b> , Mathematics, Radiology, Hydrology, Zoology, Theology, Pharmacy, and Agricultural Engineering	100% tuition grant 100% maintenance loan
2	Areas with Manpower shortage because programmes were unattractive to students in the past	<b>Business Administration, Company Secretarial Studies</b> , Chemistry, Agricultural Science, Economics, Town Planning, Statistics, Secondary School Teaching (excl. subjects in Category 1), Professional Nursing, Physics, <b>Management</b> , Geology, Entomology, Paramedical Studies, Quantity Surveying, Meteorology, Forestry, Physiotherapy, Medical Laboratory, Optometry, Microbiology, Occupational Therapy, Radiography, Speech Therapy, Property Management and Animal Health Production	100% tuition grant 50% maintenance grant 50% maintenance loan
3	Areas to encourage local capacity to increase supply of qualified manpower to satisfy the market or balance supply and demand	Law, Public Administration, Journalism, Social Work <b>Personnel Administration</b> , Political Science, Bachelor of Science, Clinical Psychology, Criminal Justice, <b>Human Resource Management</b> , Graphic Arts, Industrial Psychology, Graphic Design, Hotel and <b>Catering Management</b> , Hotel and Tourism Studies, Television Production, Film Making and Production, Fashion/Fabric Design, Criminology and Penology	100% tuition grant 100% maintenance loan
4	Programmes benefiting society and the economy but are of less priority	Philosophy, Sociology, Physical Education, Museum Studies, Humanities Courses without Post-Graduate Diploma in Education or Concurrent Certificate in Education, Library Information Studies, Archaeology and Land Board Administration	50% tuition grant 50% tuition loan 100%

5	Programmes benefiting the individual or small sections of society	Hair Dressing, Cosmetology, Photography, Music, Modelling, Performing Arts and Interior Design	maintenance
			loan
			100% tuition
			loan
			100%
			maintenance
			loan

Source: Adapted from Obasi, 2008:138-139

The subjects in each category can change at the Ministry of Education and Skills Development's discretion. Although technical skills for the diamond industry have not been included in these categories they have been identified as one the country's top six priority vocational skills. This will be discussed later in Chapter 9.

A review of the Government's tertiary funding system was undertaken in 2009, 14 years after the new funding system was introduced. This review found that although nearly 100,000 tertiary students had been sponsored, by 2008 only 8.7 per cent has studied courses in Category 1 (University World News, 2009). Based on this review, the new funding system has not been entirely successful in channelling students into Category 1, which represents areas of expertise that are in critical shortage in the country. Some of these areas, such as professional accounting and technical instructors, are directly or indirectly required by the diamond cutting and polishing firms. Furthermore, the government's cost recovery is still very low and has limited the government's ability to sponsor new students. The government recently reported that since 2003, it has recovered less than 4 per cent of the tertiary loans, which is just over \$11 million out of a possible \$2 billion<sup>19</sup> with only about 10 per cent of students currently paying back their loans (Government of Botswana, 2012). The students who are currently paying back their loans mainly work for the government and their payment is taken directly from their salaries.

<sup>19</sup> At the beginning of 2012, out of an approximate expenditure on loans of P11 847 815 103 only P68 158 902.12 has been collect since 2003.

The reason the cost recovery rate is so low is due to poor administration from the government, which does not know how much it has spent on some students (Government of Botswana, 2012). Earlier in 2012, the government announced that it would be outsourcing the tertiary education fund in order to improve its administration and the cost recovery of the loans. However, whilst government spending on education is currently taking constraints, it is clear that the government plays the most important role in financing and providing education and vocational training.

### **6.3.The Coverage of the Education and Vocational Training System**

This section uses enrolment ratios to determine the coverage of primary, secondary and tertiary schooling in order to assess how successful the education and vocational training system is at delivering education and training to Botswana's population. Botswana's enrolment levels are also compared to that of other countries in the region and countries with similar and higher incomes in order to understand the relative extent of the coverage of Botswana's education and training system. Enrolment levels are examined using the country's Net Enrolment Ratios (NER), which measure the proportion of the total population that falls within the official primary, secondary and tertiary education age groups that is enrolled in the relevant stage of the education system. So the NER measures the extent to which a country's education system has been able to reach all those who could be enrolled at each level of the education system. The data used in this section was obtained from the World Bank statistics database. The enrolment ratios used in the next three sections are from 1970 to 2010.

#### **6.3.1. The Primary Schooling System**

As was shown in Section 6.1, in all three cutting and polishing firms from which education attainment data was obtained, workers had at least obtained primary schooling. This is

because primary education is very important to the development of human capital as it provides a crucial foundation for learning and leads to considerable human development benefits. According to Pedamallu, Ozdamar and Kropat (2010:321):

“The major goals of primary education are achieving basic literacy and numeracy amongst all pupils, as well as establishing foundations in science, geography, history and other social sciences.... Some of the expected benefits from primary education are the reduction of the infant mortality rate, the population growth rate, the crude birth and death rate, and so on.”

As a result of these benefits, primary schooling is compulsory in many countries like Botswana, where it forms the first 7 of 10 years of compulsory education. According to the International Standard Classification of Education (ISCE) these years of education constitute an individual's basic education. Basic education is very important to determining the competitiveness of the diamond cutting and polishing firms because:

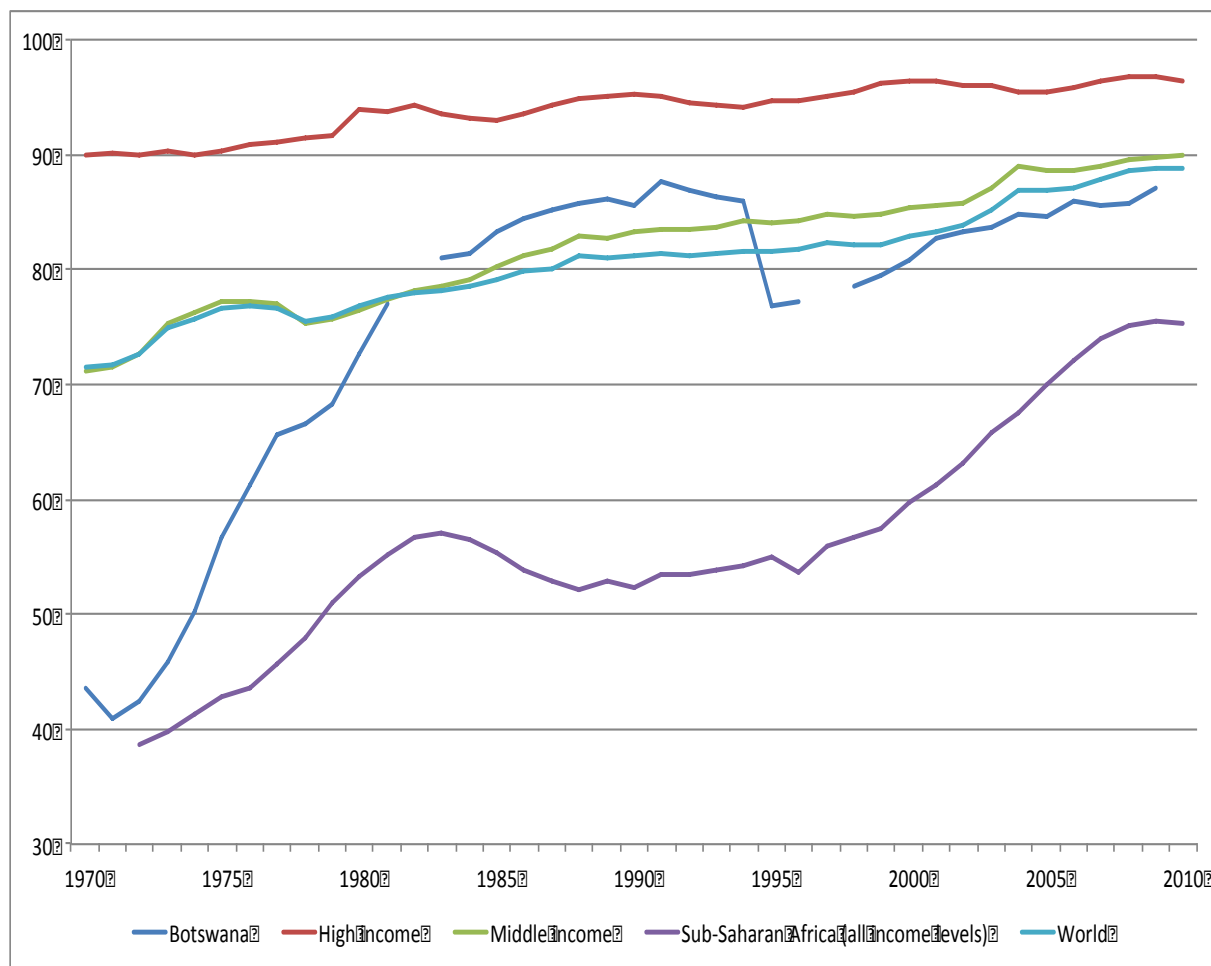
“Basic education increases the efficiency of each individual worker. Moreover, workers who have received little formal education can carry out only simple manual work and find it much more difficult to adapt to more advanced production processes and techniques. Lack of basic education can therefore become a constraint on business development, with firms finding it difficult to move up the value chain by producing more-sophisticated or value-intensive products.” (Schwab, Klaus, et al, 2009:5).

Due to the importance of basic education, all children at the school age have the right to the first ten years of schooling in Botswana. This is in line with the Millennium Development Goals (MDGs). The second of the eight MDGs is to achieve universal



primary education by the 2015. Figure 6.3 shows net enrolment in primary schooling in Botswana from 1970 compared to the average net enrolment in middle-income countries, high-income countries, sub-Saharan Africa and the world average.

**Figure 6.3: Primary school net enrolment ratio**



Source: Data from the [World Bank Statistics](#), graph by author. The data is not available for some years.

The figure shows that Botswana's primary school enrolment has increased significantly in the last four decades following independence. The net enrolment rate for children between the ages of 6 to 13 years was close to ninety-one percent in 2010 (Government of Botswana, 2010:6). This is higher than the average enrolment in sub-Saharan Africa, which was 75 per cent in 2010. Botswana's enrolment is also higher than that of other middle-income countries, which on average had an enrolment rate of 88 per cent in 2009.

Botswana's enrolment is only slightly lower than high-income countries, which on average had a net primary school enrolment of 94 per cent in 2009.

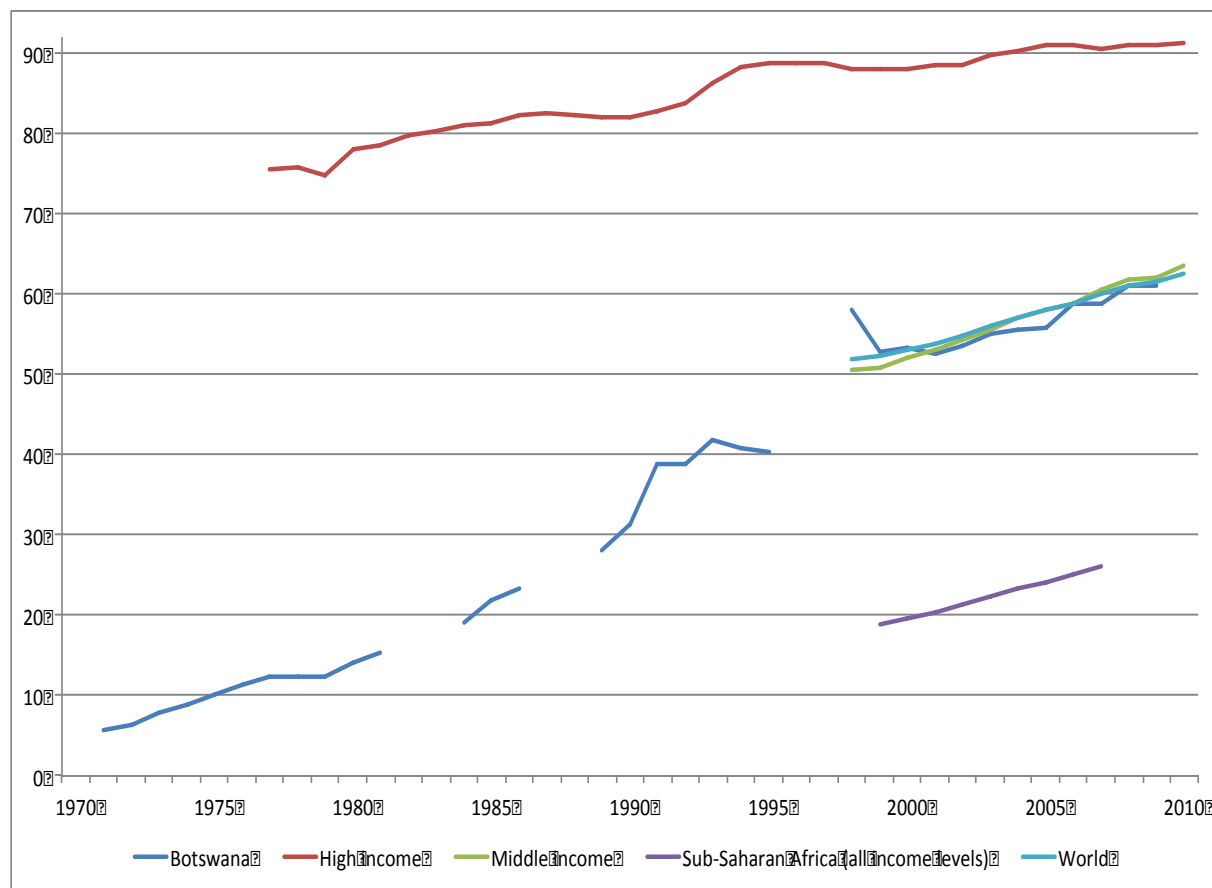
This increase in Botswana's primary school enrolment in the last four decades can be explained by the growth in the number of primary schools as well as the government's abolition of primary schooling fees in government-aided schools in 1978. In 1978, Botswana only had 376 primary schools (UNESCO, 2007). By 2010, this figure had more than doubled to 805 schools (Government of Botswana, 2010:3). In 1970, only 44 per cent of children of the official age were enrolled in primary schools. By 1990, this figure had more than doubled to 87 per cent. After 1990, primary school enrolment growth started to decrease and by 1996 net enrolment had fallen by 10 per cent. According to the Ministry of Education, this fall in enrolment was due to high drop out rate and a high rate of failure especially in primary schools in rural locations where the supply of education facilities was low, teachers were not supportive of learners, and students faced logistical problems like long travelling distances to reach schools (Government of Botswana, 1997:18). Improvements to primary school enrolment have been made since the fall in enrolment experienced in the 1990s, with the net enrolment ratio going back to the pre-1991 level of 96 per cent by 2009.

### **6.3.2. The Secondary Education System**

Despite the improvements made to primary schooling enrolment, the education system has struggled to retain students in secondary education with only forty per cent of students enrolled in primary school in 1990 managing to reach senior secondary school by 2001 (Lekoko & Maruatona, 2005:7). This has implications for the cutting and polishing firms who, as was shown in Section 6.1, employ workers who have obtained secondary education. The problem of retention in the education system is demonstrated by the lower secondary school net enrolment ratios. Figure 6.4 shows Botswana's secondary school net

enrolment ratios from 1970 compared to the average net enrolment in middle-income countries, high-income countries, sub-Saharan Africa and the world.

**Figure 6.4: Secondary school net enrolment ratio**



Source: Botswana's data from [UNESCO Data](#), rest of the data from [World Bank Statistics](#) and graph by author. The data is not available for some years.

Figure 6.4 shows that there has been a large increase in the secondary school enrolment ratio in the last four decades from 5.7 per cent in 1970 to about 61 per cent in 2009. Although this is a great improvement, close to two fifths of the population of secondary school age is still not enrolled in secondary education. However, Botswana's net enrolment for secondary school is comparable to the average enrolment for other middle-income countries as well the world average. Furthermore, it is much higher than the sub-Saharan African average, which was only 27 per cent in 2008. But it is considerably lower than that

of high-income countries, which had managed, on average, to achieve a secondary school enrolment of just over ninety per cent in 2008.

### **6.3.3. The Tertiary Education and Vocational training System**

As was shown in Section 6.1, a significant proportion of workers in diamond cutting and polishing firms have tertiary education. For example in Firm A and Firm B, 67.5 per cent and 50 per cent of workers respectively had received tertiary education. Botswana's tertiary education and vocational training system is still largely undeveloped and in the past Botswana had to rely on other countries, particularly South Africa, to provide tertiary education due to limited capacity in local tertiary institutions. However, at the beginning of the 1990s, Botswana started reforming its tertiary education system:

“The reforms focus on increasing access to, and equity in, tertiary education; improving the quality of provision; ensuring the relevance of programmes to learners and society; and promoting a focus on research and development” (Molutsi, 2008:136).

For example, in 1994, the country's first education policy was revised, resulting in the Revised National Policy on Education which aimed to expand the tertiary education market by including the participation of private providers. Previously the government had been the only provider of tertiary education. Other reforms to increase access to the tertiary system included expanding local capacity by increasing the number of publically owned tertiary institutions and expanding existing ones. For example, historically, Botswana's tertiary education system consisted of only one university, the University of Botswana. But a second university, which will specialise in science and technology education, is currently being established and the University of Botswana has recently established the country's first medical school. The role of the university in the creation of knowledge and skills in

the economy deserves particular attention because:

“In a knowledge economy, universities are considered to be key institutions for the production of high-level skills and knowledge innovation, based on the traditional core business of universities – the production, application and dissemination of knowledge” (Bailey, Cloete & Pillay, 2010:3)

In order to further foster the development of the tertiary education and vocational training system, the government established the Tertiary Education Council (TEC) and the Botswana Training Authority (BOTA) in 1999 and 2000, respectively. The TEC’s mission “is to plan, develop and coordinate a well resourced quality tertiary education system contributing to Botswana becoming a knowledge-based society”<sup>20</sup>. The TEC is in charge of formulating and implementing policy for the tertiary education system. The BOTA is in charge of coordinating “an integrated accessible vocational training system that meets the needs of the learners and industry through the development of standards, quality assurance, policy advice, monitoring and evaluation”<sup>21</sup>. These needs vary for each industry and BOTA aims to address the technical skill requirements of the diamond cutting and polishing industry through the vocational training system. These plans will be discussed in detail in Chapter 9.

Unlike the net enrolment ratio that was previously used in this chapter, which only captures the population of children at the official school-going age, gross enrolment ratio measures the ratio of students enrolled in a level of education regardless of their age. The gross enrolment ratios are used to show performance of the absorption of students into the tertiary system regardless of their age since for various reasons, such as grade repetition, some students in tertiary education may be older than the conventional tertiary-level age

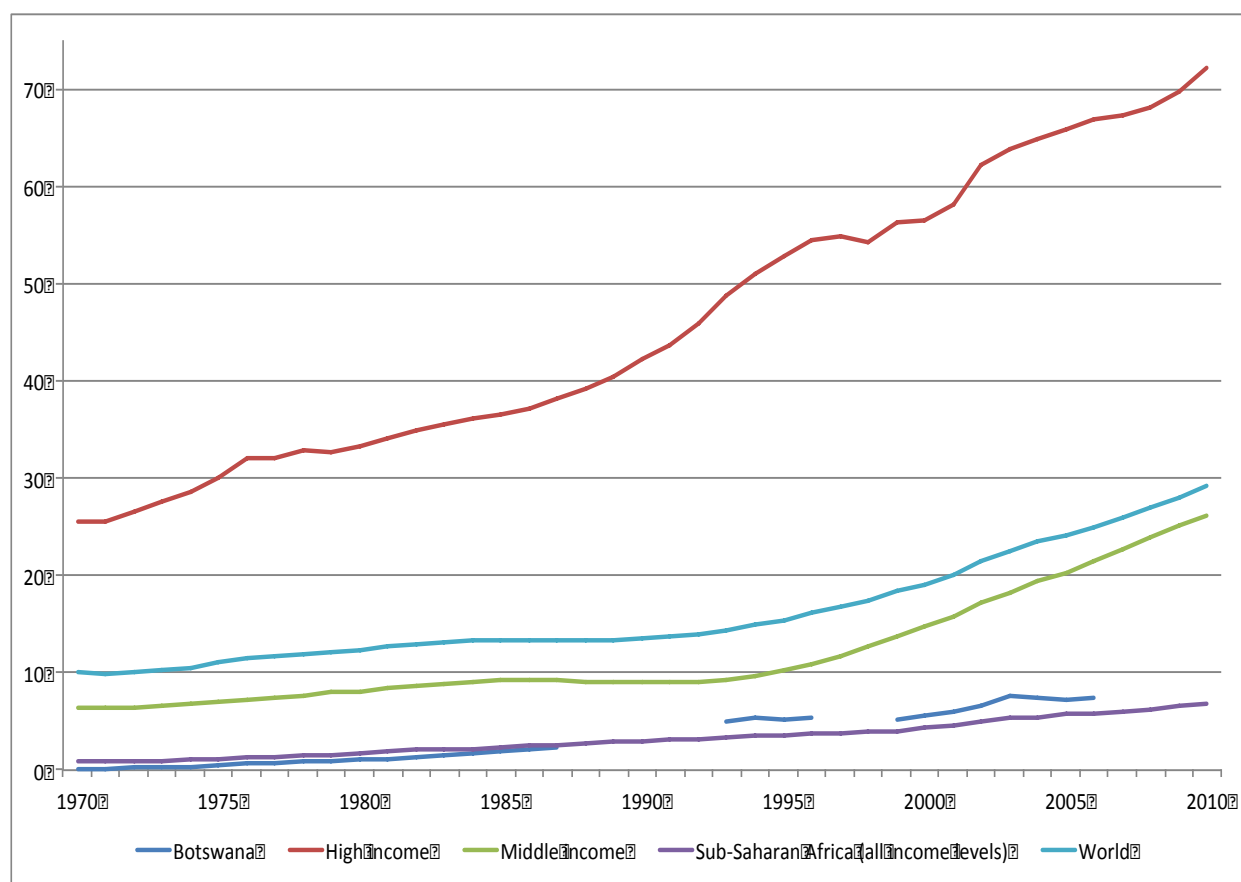
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<sup>20</sup> <http://www.tec.org.bw/tec-about-tec.php?pid=1&sub=TEC%20Overview>

<sup>21</sup> <http://www.bota.org.bw/index.php?r=site/page&view=foreword>

(i.e. mature students). Figure 6.5 indicates Botswana's tertiary gross enrolment ratios from 1970 compared to the average gross enrolment in middle-income countries, high-income countries, sub-Saharan Africa and the world. This figure significantly underestimates tertiary enrolment as it includes only students enrolled in local tertiary institutions and not students studying abroad, who represented about 28 per cent of Botswana's total enrolment in 2007.

**Figure 6.5: Tertiary gross enrolment ratio**



Source: World Bank Statistics, graph by author. The data is not available for some years.

The figure shows that the growth in gross enrolment in local tertiary education was very limited in the last four decades. In the 1970s, Botswana's tertiary gross enrolment ratio was less than one per cent and, more three decades later in 2007, it had only risen to just over seven per cent. Botswana's tertiary education coverage is very low especially when compared to the world average of twenty five per cent in 2007 but slightly higher than the

sub-Saharan Africa average of around six per cent in the same year. However, for a middle-income country Botswana's tertiary enrolment remains low with the average middle-income country enrolment of twenty-four per cent in 2009. Thus for a middle-income country a very small proportion of the population in Botswana proceeds into the tertiary education system. This suggests there is a significant lack of capacity in providing the higher level of skill sets that are required by many firms, including the diamond cutting and polishing firms. In order to understand where students that do manage to proceed to the tertiary education and vocational training system enrol, the rest of this section discusses enrolment in both local and international institutions.

### *Local Enrolment*

Table 6.4 shows the breakdown of enrolment in local institutions in 2007 according to the most recent Labour Force Survey. It also shows the gender distribution of students in each of these types of institutions.

**Table 6.4: Local enrolment into tertiary institutions by gender (2007)**

	<i>Male</i>	<i>Female</i>	<i>Total</i>
Teacher Training Colleges	32%	68%	<b>5%</b>
	<i>439</i>	<i>951</i>	<b><i>1,390</i></b>
Vocational Training Colleges	62%	38%	<b>35%</b>
	<i>6,305</i>	<i>3,789</i>	<b><i>10,094</i></b>
Education Colleges	42%	58%	<b>4%</b>
	<i>480</i>	<i>674</i>	<b><i>1,154</i></b>
Agricultural College*	71%	28%	<b>3%</b>
	<i>683</i>	<i>268</i>	<b><i>960</i></b>
University of Botswana	48%	52%	<b>53%</b>
	<i>7,404</i>	<i>8,073</i>	<b><i>15,477</i></b>
<b>Total</b>	<b>52.7%</b>	<b>47.3%</b>	<b>100%</b>
	<b><i>15,310</i></b>	<b><i>13,765</i></b>	<b><i>29,075</i></b>

Source: Central Statistics Office's Labour Force Survey (2008), \*2006 Enrolment Figures.

According to the most recent Labour Force Survey data shown in Table 6.4, close to 30,000 students were enrolled into Botswana's local tertiary institutions in 2007 and this enrolment was split almost equally between males and female students. More males were enrolled in agricultural and vocational and technical training but more females were enrolled in education colleges, which train teachers. In 2007, the government funded over ninety per cent of the students in local institutions such as at the University of Botswana, Botswana College of Agriculture, Institute of Health Sciences, Colleges of Education and the Botswana Accountancy College (Ministry of Labour, 2007). In 2004, only 28 per cent of students were enrolled in private institutions. By 2008, this figure had increased to 43 per cent as a result of policy reforms that increased the number of private tertiary institutions (Molutsi, 2008).

#### *University of Botswana*

About half of the students enrolled in local institutions were enrolled at the University of Botswana, which is the only broad-based university currently operating in Botswana. The University of Botswana was previously known as the University of Botswana, Lesotho and Swaziland until it became a separate national university in 1982. The university has eight faculties that offer both undergraduate and postgraduate courses leading to the award of certificates, diplomas, and degrees. The University of Botswana's faculties are: Education, Engineering and Technology, Graduate Studies, Health Sciences, Humanities, Sciences, Social Sciences, and Business Studies. Programmes in the Business Studies faculty are especially relevant for ancillary jobs in management and other support services in the diamond cutting and polishing industry, such as accountancy and Information Technology (IT) as discussed in Chapter 5. Table 6.5 shows enrolment numbers and percentages in 2007/8 academic year by faculty in the university.



**Table 6.5: University of Botswana enrolment by faculty (2007/8)**

	<i>Number</i>	<i>Percentage</i>
Business Studies	3,826	25%
Education	2,200	14%
Engineering & Technology	1,470	9%
Graduate Studies	1,029	7%
Health Sciences	305	2%
Humanities	2,677	17%
Sciences	1,643	11%
Social Sciences	2,334	15%
<b>Total</b>	<b>15,484</b>	<b>100%</b>

Source: University of Botswana (2008)

According to the university, over 15,484 students were enrolled in the eight faculties in the 2007/8 academic year. The majority of enrolments are in the Humanities and Social Sciences and Education faculties, which together represented 46 per cent of total enrolment. The Sciences faculty only accounted for about a tenth of enrolments, whilst Engineering and Technology faculty only represented 9 per cent of enrolment. The Business Studies faculty's enrolment was only a quarter of total enrolments. The university produces relatively more skills for careers in the humanities and social sciences and less for careers in commerce. The implications of this focus will be discussed in Chapter 9.

### *Vocational Training Colleges*

After independence, Botswana's government neglected vocational training "in favour of producing a workforce that could take over the white-collar jobs being vacated by foreigners" (OECD, 2008:161). Since the skills needed for white-collar jobs are mainly produced in the universities, the government supported the university sector at the expense of vocational training. Due to this neglect, the provision of vocational training in Botswana has been fragmented and of uneven quality (OECD, 2008). However, the government is currently giving priority to the vocational and technical training system because it sees

technical skills as being crucial to determining whether or not Botswana achieves its development objectives.

In 1997, the government introduced the National Policy on Vocational Education and Training to reform the vocational training system and address more effectively the country's vocational and technical skills requirements. The policy provides the broad framework within which training activities will be carried out and, in 1998, the government passed the Vocational Training Act, which led to the introduction of the Botswana National Vocational Qualification Framework (BNVQF). Before the introduction of this act there had not been a standard qualification framework in Botswana's vocational training system. The aim of the framework was not only to increase the quality of vocational training but also to improve the alignment of the demand and supply of vocational training. The policy reforms aimed to make the provision of vocational training more systematic.

The first vocational training schools, known as Brigades, were started around the time of independence as a result of the efforts of educationalist Patrick Van Rensburg. These Brigades were started as autonomous community-based schools that provided vocational training alongside income-generating production activities, with students using the skills they learnt, such as bricklaying and carpentry, to produce goods and services that were sold to the community to raise funds that were used to offset the costs of training. Generally, the students at the Brigades had completed primary school and could not get admitted into secondary schools. In 1975, the Brigades became government-aided with the government starting to subsidise their training costs. Botswana's agricultural colleges were started in 1970, followed by the government's first vocational training colleges, which were opened in 1987.

In 2007, just over a third of local tertiary students (10,094) were enrolled in vocational training colleges, and only 3 per cent (960) of tertiary students were enrolled in agricultural colleges (see Table 6.4). There are currently 7 operational government-owned vocational training colleges in Botswana with plans to increase numbers. The government is also in the process of taking over the management and administration of the 41 Brigades to change them from being community-based to being part of government-owned vocational institutions. So far, 21 Brigades have been taken over by the government. The private sector has also started vocational training colleges. The major private vocational training colleges are related to the mining sector. These are owned and run by the main mining companies, like Debswana's Orapa Training Centre that produces mining-related technical skills.

The government-owned Madirelo Training and Testing Centre (MTTC) is in charge of issuing the vocational training certificates for various trades such as brickwork, carpentry, painting, plumbing, welding and fabrication. The MTTC was started in 1988 with support from the German Development Agency (GTZ) and it is modeled on the German apprenticeship system (discussed in Chapter 4). Like the German model, Botswana's apprenticeship scheme combines formal vocational training with on-the-job training for 3 to 4 years. An apprentice needs a minimum of a junior secondary school certificate as well as a sponsoring company that specializes in the vocation that they wish to train in. The apprentices are then placed in a vocational college where they undergo institutional training for 3 months every year. During this time they undergo theoretical training, and once they pass their theory exams, they go for practical on-the-job training for 9 months, and subsequently sit practical tests. Employers that participate in the apprenticeship programme pay the apprentices' salaries or allowances and other costs associated with training. The training companies pay a training levy, which enables them to get a 200 per cent rebate for their training costs. After the 3 or 4 years of the apprenticeship, the

apprentice writes the final National Craft Certificate Examinations to qualify as a fully certified artisan. The certificates awarded by MTTC will be discussed in Section 6.4, which discusses the outcomes of Botswana's education and vocational training system.

Unlike tertiary education, technical and vocational training falls under the Ministry of Labour and Home Affairs rather than the Ministry of Education and Skills Development. The implications of this will be discussed in the Chapter 9. Vocational training is regulated by the Botswana Training Authority, which, as discussed at the beginning of this section, provides quality assurance, accreditation, monitoring and evaluation to vocational training and education institutions. Despite the recent changes made to the vocational training system, at the end of 2009 government-owned vocational colleges were reported to be running under capacity, facing high staff turnover, unable to run some programmes, and in need of improving the quality of their training (Interview with senior education official, Gaborone, November 2009). Furthermore, there is a "mismatch of vocational and technical skills supply and demand for artisans and technicians, which is evident in the high unemployment of vocational training graduates..." (BOTA, 2010:13), resulting from the wrong types of vocational skills being produced. So despite the attempts to improve Botswana's vocational training system, the system is still facing a number of challenges that are affecting the quality and relevance of human capital produced in the system.

### *International Enrolment*

Due to a lack of capacity and the absence some programmes in the local tertiary institutions, the Ministry of Education sponsors students to study abroad, most notably in South Africa, Malaysia, Australia, New Zealand, Canada, the United States of America and the United Kingdom. This represents a great cost. Between 2004 and 2005, the cost of sending students abroad represented 93 per cent of the expenditure of the Department of

Tertiary Education Financing. Table 6.6 shows the estimates for the number and cost of government-sponsored students abroad in 2004 and 2007.

**Table 6.6: Estimate of number and costs of government-Sponsored students abroad in 2004 and 2007**

<i>Country</i>	<i>2004</i>		<i>2007</i>	
	<i>No. of Students</i>	<i>Total Cost (US\$)</i>	<i>No. of Studenst</i>	<i>Total Cost(US\$)</i>
Australia	550	14,666,667	537	16,468,000
United Kingdom	700	38,500,000	629	39,784,250
United States of America	488	10,483,333	232	15,118,667
Canada	137	4,914,875	123	5,074,519
Malaysia	152	1,950,667	1,218	17,975,650
South Africa	7,012	81,806,667	4,963	66,586,917
Other	327	10,829,604	398	15,158,134
<b>Total</b>	<b>8,585</b>	<b>180,321,813</b>	<b>8,100</b>	<b>176,166,136</b>

Source: UNESCO and Botswana Ministry of Education Statistics found in Maiketso (2009)

In 2004 and 2007, the number of students sponsored abroad was over 8,000, which was equivalent to about 28 per cent of the locally enrolled students in 2007. In 2004, the largest proportion of students was in South Africa and the second largest proportion was in the United Kingdom. By 2007, the UK had been overtaken by Malaysia due to a large number of students being sent to Malaysia instead of the UK in order to lower costs. In 2004, the government spent over US\$180 million sponsoring students abroad, and this decreased slightly to about US\$176 million in 2007. Between 2010 and 2011 the costs of sending students abroad decreased significantly from 93 per cent to only 38 per cent of government-sponsorship expenditure. This was due to the global recession, which has led to a significant decrease in government spending and a redirecting of government spending from sending students abroad to increasing capacity in local tertiary institutions as this is relatively cheaper. The decline of public expenditure on higher education as a result of the

global recession has been a trend amongst most countries (Tilak, 2006) and Botswana has not been an exception.

## **6.4.The Outcomes of Botswana’s Education and Vocational Training System**

This section aims to assess the outcomes of Botswana’s education system by investigating the nature and level of general human capital it produces. This discussion will focus on how the basic human capital required by the diamond cutting and polishing industry is formed in the education system, such as basic literacy and the relevant vocational skills.

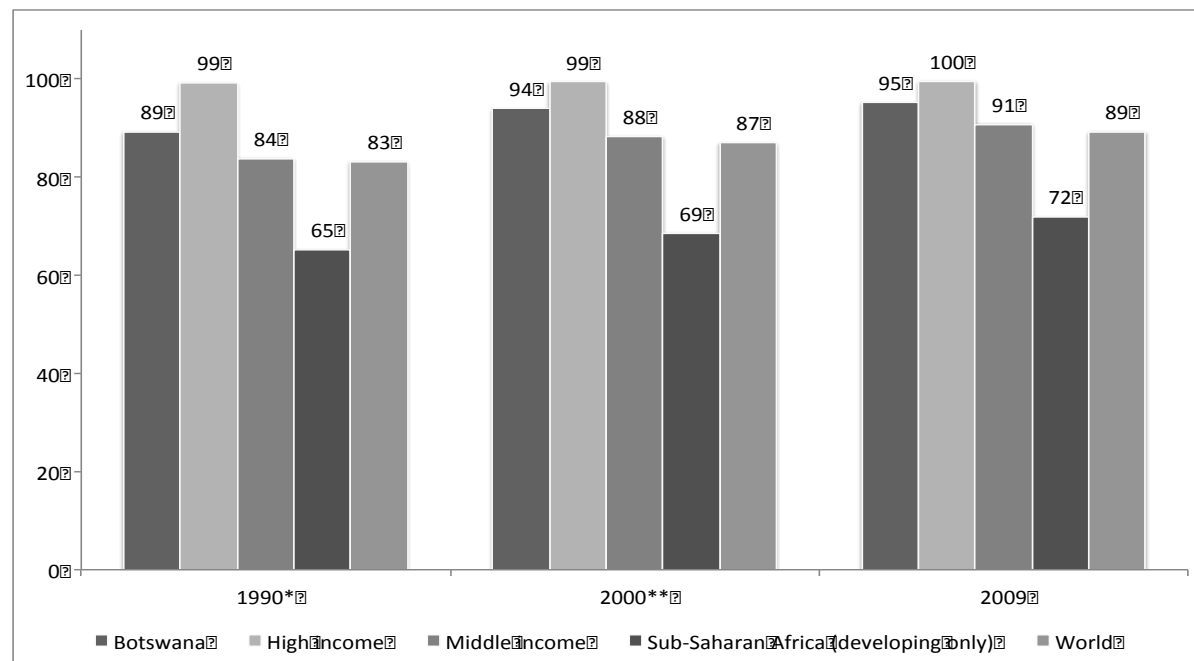
### **6.4.1. Adult Literacy**

Adult literacy measures the percentage of the working age population that is literate, that is people over the age of 15 who can read and write. The formal definition for a literate person adopted by UNESCO in 1978 is “one who can, with understanding, both read and write a short simple statement on his or her everyday life” (UNESCO, 2006:153). Literacy is a commonly used indicator of the state of human capital because it is widely available and comparable between countries and regions. In 1970, only forty-nine per cent of adults in Botswana were literate (Presidential Task Group, 1997:14). By 1990 this had risen significantly to eighty-nine per cent and by 2009 it had risen even further to ninety-five per cent (see Figure 6.6).

As Figure 6.6 shows, Botswana’s literacy rate is higher than that in other middle-income countries and close to that of high-income countries. It is much higher than the sub-Saharan Africa average, which had risen from sixty-five to seventy-two per cent between 1990 and 2009 and remained below the world average, which reached eighty-nine per cent in 2009. Botswana’s progress in achieving these high rates of literacy is remarkable. Its

commitment to education is relatively recent, yet its performance is superior to that of most other middle-income countries that have long had developed education systems.

**Figure 6.6: Adult (population over 15 years) literacy rates**



Source: World Bank Statistics, chart by author

However, the way UNESCO measures literacy has been criticised for being too narrow for not “linking the development of reading and writing and numeracy skills to the development of skills in other areas reflecting the socio-economic and cultural needs of learners” (Hanemann, 2006:5). In response to these limitations, Botswana has adopted a national definition of literacy, which it used in the National Literacy Surveys conducted in 1993 and 2003. This extends the general definition by defining literacy as:

“...a responsive and context specific multi-dimensional lifelong learning process designed to equip beneficiaries with specialised knowledge, skills, attitudes and techniques to independently engage in practices and genres involving listening, speaking, reading, writing, numeracy, technical functioning and critical thinking required in real life. (Government of Botswana, 2003:3)

The National Literacy Survey compiled its adult literacy data based on a test to determine the ability to read and write amongst the respondents. The literacy rate in the survey was determined by computing a mean score based on English and Setswana reading, writing, oral tests as well as numeracy. The last survey conducted in 2003 found a national literacy rate of eight-one per cent. This was an improvement from the literacy rate of sixty-nine percent found in the 1993 survey. This is slightly lower than UNESCO measure of literacy of 94 per cent in 2000.

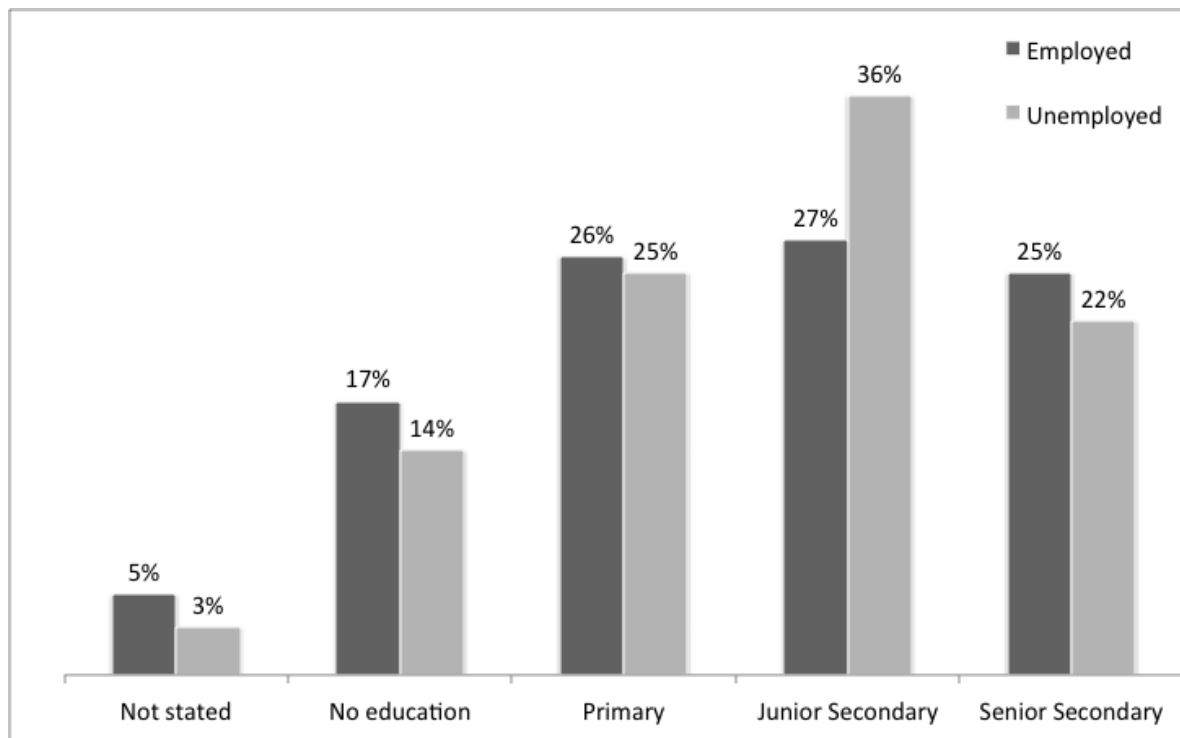
However, even with the improved methods of determining adult literacy, the National Literacy Survey it is still a limited indicator of the state of human capital because it does not capture other important aspects of human capital, such as worker skills and productivity (Miyamoto, 2003: 17). For example, although the diamond cutting and polishing industry requires that all workers have basic literacy, it also requires that workers have other skills and qualities relevant to their job in the firm. Thus it is important to look at other indicators of the state of the human capital formed in the education and training system. Therefore the rest of this section will examine the level of education and training in the labour force, in order to further understand the state of human capital in Botswana's labour force.

#### **6.4.2. Level of Education and Training in the Labour Force**

This section examines the level of education and training in the overall labour force both for the employed and unemployed. Figure 6.7 shows the distribution of educational attainment in the labour force. These stats do not include tertiary education, which instead is recorded as training attainment and is shown in Figure 6.8.

**Figure 6.7: Highest level of education completed by the labour force (2005/6)**



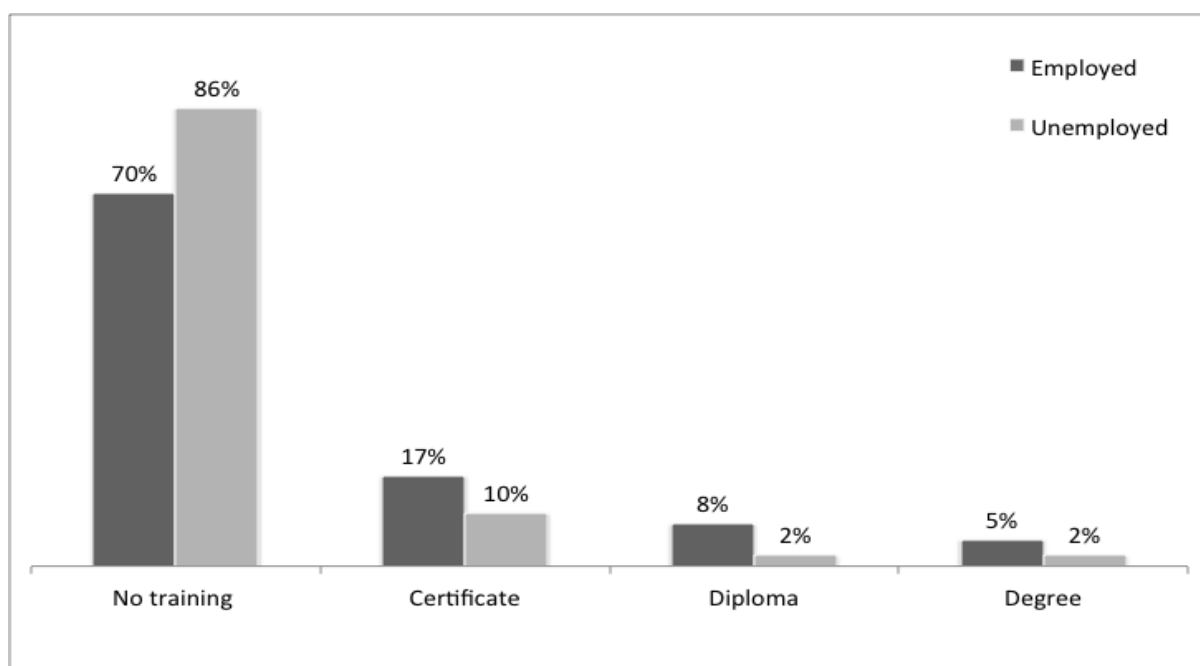


Source: data from the Central Statistics Office, chart by author

Amongst the employed close to a fifth have no education whilst just over three quarters have primary, junior secondary or senior secondary education as their highest level of education. Interestingly, amongst the unemployed, a slightly smaller percentage (fourteen per cent) has no education. Two quarters of unemployed people only have primary education or secondary education, whilst over a third of unemployed people have junior secondary as their highest level of schooling. Thus the largest proportion of unemployed people obtained only junior secondary schooling. As will be shown in Chapter 8, this is generally the minimum education required by the cutting and polishing industry for the majority of firms' production-related workers.

Figure 6.8 shows the distribution of training qualifications in the labour force, which include tertiary education. Training can also be in the form of certificates, which are mainly awarded in the vocational training colleges, or diplomas and degrees, which are mainly awarded in other higher education institutes and universities.

**Figure 6.8: Highest level of formal training in labour force (2005\6)**



Source: data from the Central Statistics Office, chart by author

A very large percentage of employed and unemployed members of the labour force, seventy per cent and eighty six per cent respectively, have not received any formal training. Amongst those who have received formal training, whether employed or unemployed, the largest proportion has certificates. Interestingly, a higher proportion of the labour force with certificates is unemployment. Only five per cent and two per cent respectively of the employed and unemployed have a degree qualification.

In order to further understand the human capital formed in Botswana's education and training system, the next section discusses the performance of students in national examinations written at the different levels of the education system.

#### **6.4.3. The Performance of Students throughout the Education System**

The section will start with pass rates in the primary schooling system, followed by pass rates in the secondary schooling system. The exams written at the end of primary schooling

are known as the Primary School Leaving Examinations (PSLE). Table 6.7 shows the results for students who achieved a C<sup>22</sup> grade or higher for the PSLE in 2007 and 2011.

**Table 6.7: Percentage Primary School Leaving Examinations (PSLE) graded C or higher**

	<i>2007</i>	<i>2011</i>
Overall	72.9%	64%
English	70.4%	61.9%
Mathematics	67%	53.3%
Science	63.6%	49.4%

Source: Botswana Examinations Council

In 2011, only 64 per cent of students managed to get an overall grade of C or higher for their PSLE, this represents 27,140 out of 42,422 students that wrote the examinations meaning that a large proportion of students proceeded to junior secondary even though they had obtained a grade lower than C. The 2011 results were a decrease from the 2007 results, when 72.9 percent of student managed to achieve an overall C grade or higher, this represented 28,785 out of 42,217 students who wrote the examinations that year. In 2011, results for English, Mathematics and Science<sup>23</sup> had deteriorated when compared with those for 2007. For example, in 2011 only 53.3 per cent of students achieved a grade C or higher for Mathematics, compared with 67 per cent 2007. Although for their overall grade the majority of students get a grade C or higher for their PSLE, the subject grades in Mathematics, English and Science are much lower, and both overall grades and the subject grades have decreased significantly since 2007. The fall in results since 2007 could be due to the change in the policy that stopped students from repeating a grade if they performed

<sup>22</sup> Botswana grades exams as follows: A – 80 per cent or above, B – 70 to 79 per cent, C – 60 to 69 per cent and D is 50 to 59 per cent.

<sup>23</sup> Other PSLE subjects are: Setswana, Social Studies, Agriculture and Religion and Moral Studies

poorly, before this policy change students were allowed to repeat a grade in order to improve their performance.

The last three years of the 10 years basic schooling take place in junior secondary school, thus it is important that students have access to the first three years of secondary schooling. In order to ensure that all students, whatever their educational attainment, qualify for the full 10 years of compulsory education, the government made a key reform to the education system during the country's seventh National Development Plan that was implemented from 1991 to 1997. As a result of this reform, the Primary School Leaving Examinations (PSLE) that are written at the end of primary school no longer determine whether a student can progress to junior secondary school. So even if a student fails PSLE, they are still able to progress to junior secondary school. This has led to an increase in the retention rate from primary education to junior education, which was only 57.9 per cent in 1990. After the policy reform was implemented, it increased to 74.4 per cent in 1991 and was almost 100 per cent by 2004 (see Table 6.8). This was much higher than the average Sub-Saharan progression rate of 61.38 per cent in the same year.

**Table 6.8: Progression rate to junior secondary education**

	<i>1990</i>	<i>1991</i>	<i>2000</i>	<i>2004</i>	<i>2006</i>
Botswana	57.9%	74.4%	95.7%	98.8%	97.3%
Sub-Saharan Africa				61.38%	

Source: World Bank Statistics

However, as shown by Figure 6.10 a large proportion of students in Botswana do not progress to senior secondary school. This is because the prerequisite for students to progress to senior secondary school is that they need to have passed their Junior Certificate Examinations (JCE), which are written at the end of junior secondary schooling. To

illustrate the progression from junior secondary to senior secondary, Table 6.9 shows the percentage of students who wrote JCE and managed to achieve a C grade or higher in 2007 and 2011. Only students who achieve a C grade or higher are able to progress to senior secondary school.

**Table 6.9: Junior Certificate Examinations (JCE) Awarded C Grade or higher**

	<i>2007</i>	<i>2011</i>
Overall	75.1%	74.7%
English	27.3%	26.3%
Mathematics	22.8%	21.1%
Integrated Science	25%	24.4%

Source: Botswana Examinations Council

In 2011, 74.7 per cent of students managed to pass their JCE; this represented 29,285 of 39,374. This was a slight decrease from the 2007 figure of 75.1 per cent. This means that about a quarter of students, over 10,000, were not able to progress to senior secondary school. Based on the subject pass rates for English, Mathematics and Science, the JCE results are even less impressive. For example, only 21.1 per cent of students managed to achieve a grade C or higher for Mathematics, which was a fall from the 2007 figure of 22.8 per cent. Although the majority of students managed to pass their JCE and could progress to senior secondary, their subject pass rates for English, Mathematics and Science were significantly lower than the overall pass rate.

Students who cannot proceed to senior secondary and choose not to rewrite their JCE<sup>24</sup> can follow the non-academic route in the vocational training system. However, as shall be shown later, Botswana's vocational training system is weak and does not produce a

<sup>24</sup> Botswana's education system enables students who fail to rewrite some or all of their junior secondary subjects through Botswana's College of Open Learning or other adult learning colleges.

significant quantity of skilled workers for the industries that require them, including for the diamond processing industry. This creates a large pool of youths who are outside the education system and can acquire training only through industry or firm training.

At the end of the last year of senior secondary school, students write Botswana's General Certificate of Secondary Examination (BGCSE) and their results determine their entry into the tertiary education system. In order to get a sense of the proportion of students that qualify for tertiary education after completing senior secondary school, Table 6.10 shows the percentage of students awarded a grade C or higher in 2007 and 2011 for selected subjects.

**Table 6.10: Percentage of Botswana's General Certificate of Secondary Examination (BGCSE) results awarded at grade C or higher**

	<i>2007</i>	<i>2011</i>
All Subjects (i.e. % of subjects awarded grade C or higher)	40.69%	30.86%
English Language	23.74	17.47
Mathematics	29.27%	26.97%
Science (Biology, Chemistry and Physics)	41.73%	21.36%

Source: Botswana Examinations Council

In 2011, only 30.86 per cent of results across all subjects were at grade C or higher. This was a significant decrease of about 10 per cent compared to the 2007 figure. Amongst the 28,702 students that sat the BGSCE in 2011 only 6,129 managed to achieve 5 Cs or better for the subjects they wrote. This represented only 21.35 per cent of entrants and was a fall from 30.92 per cent in 2007. For English, Mathematics and Science, the percentage of grades awarded a C or better in 2011 compared to 2007 also decreased. For example, the percentage of students that achieved a C grade or better for Science fell from 41.73 per cent in 2007 to 21.36 per cent in 2011. Since the entry requirements for the different types

of tertiary institutions vary it is not possible to determine what proportion of students proceed to tertiary institutions based on BGSCE results. What is clear from the BGSCE results is that only a small proportion of students in Botswana do well in their final secondary schools exams.

In order to understand the types and quantity of human capital formed in Botswana's tertiary and vocational training, the next section discusses the number of graduates from local tertiary institutes. Figure 6.11 shows the number of graduates produced by the University of Botswana between 2000 and 2010 according to the faculty groups they graduated from. Compared to 2000, in 2010 the overall number of graduates at the University of Botswana has decreased from 3,205 to 2,974 after the number of graduates had risen between the 2001/2 and 2006/7 academic years. During this decade, the highest number of graduates came from the Humanities faculty.

**Table 6.11: The number of graduates produced by the University of Botswana (2007/8)**

	<i>Science and Technology</i>	<i>Business</i>	<i>Humanities</i>	<i>Total</i>
<b>2000/1</b>	583	650	1970	3203
<b>2001/2</b>	607	614	2106	3327
<b>2001/3</b>	611	533	2397	3451
<b>2003/4</b>	573	599	2095	3267
<b>2004/5</b>	678	637	2102	3417
<b>2005/6</b>	625	706	2188	3519
<b>2006/7</b>	591	634	2384	3609
<b>2007/8</b>	580	538	2033	3151
<b>2008/9</b>	583	577	1754	2914
<b>2009/10</b>	554	673	1647	2874

Source: Bailey, Cloete & Pillay, 2010

Table 6.12 shows the vocational training certificates awarded by the Maiterelo Training and Testing Centre (MTTC), discussed in Section 6.3.3 from 1997 to 2005, as well as

those awarded in 2011. The data for 2006 to 2010 could not be obtained from the Ministry of Labour and Home Affairs, it is also not clear if data for some of the trades were missing or if no certificates were awarded for those trades in 2011. The trades identified in Chapter 5 as being directly relevant to the diamond cutting and polishing industry have been written in bold. This data shows that between 1997 and 2005, the number of overall vocational training certificates issued by MTTC increased from 2,488 to 4,955. However, in 2011 they had decreased to 3,321 certificates. As discussed in Section 6.3.3, despite reforms to improve vocational training, it would appear that the system is still underperforming.

**Table 6.12: Vocational training certificates issued from 1997 to 2005 and 2011**

<i>Trade</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>	<i>2001</i>	<i>2002</i>	<i>2003</i>	<i>2004</i>	<i>2005</i>	<i>2011</i>
<b>Auto electrical</b>	265	146	156	205	196	268	203	279	305	-
Auto mechanics	251	286	159	163	352	405	512	498	603	421
Agriculture	113	98	103	64	98	112	145	78	256	494
Bricklaying	356	138	289	306	356	379	406	568	702	718
Cabinet making	219	138	159	198	208	345	375	380	408	-
Carpentry	245	245	265	243	550	568	605	615	605	614
<b>Electrical</b>	175	206	276	238	264	288	306	308	315	186
<b>Fitter machinist</b>	103	64	76	35	16	35	12	43	64	30
Heavy plant	89	65	49	82	105	106	106	115	130	-
Hotel/catering	68	35	46	12	19	85	35	46	59	-
Painting	95	65	113	156	189	143	112	120	135	47
Panel beating	105	65	58	67	92	65	101	45	87	51
Plumbing	167	111	89	116	168	190	204	304	270	176
Welding	165	132	154	165	189	205	206	275	306	205
<b>Instrumentation</b>	0	0	0	0	0	0	6	2	3	-
Power plant	54	18	52	468	23	46	105	116	248	-
Heavy plant operators	0	0	0	0	0	29	49	69	370	-
<b>Refrigeration</b>	8	20	64	52	36	46	59	67	89	39
Dressmaking	-	-	-	-	-	-	-	-	-	340
<b>Total</b>	<b>2488</b>	<b>1832</b>	<b>2108</b>	<b>2518</b>	<b>2825</b>	<b>3315</b>	<b>3547</b>	<b>3928</b>	<b>4955</b>	<b>3321</b>

Source: 1997 to 2005 data from Siphambe (2007) found in Sekwati and Naranyana (2011) and 2011 data from the Ministry of Labour and Home Affairs



In terms of trades directly relevant to the cutting and polishing industry, firstly, MTTC does not provide training in some of the most important technical skills, such as those associated with laser technology. Secondly, in the relevant trades where training is provided the number of certificates issued was still very low in 2011. For example only 30 certificates were issued for Fitter Machinists and none were issued for Instrumentation. The trade certificates data shows that the vocational skills produced in the public vocational training system are more geared towards careers such as, the construction industry and automotive repair. Thus, overall, the public vocational training system either produces a low level of the relevant technical skills for the cutting and polishing industry or it does not produce the relevant technical skills at all. Chapter 7 will discuss the extent to which diamond cutting and polishing institutes fill the gap in the provision of relevant technical skills for the industry.

## **6.5. Conclusion**

The chapter found that the government spends a considerable amount on education, which has led to significant human capital gains since independence. Botswana's adult literacy rate and education enrolment rates, except for tertiary and vocational training, are impressive for a middle-income country. However, Botswana's pass rates at the primary and secondary levels of the education system have fallen. Furthermore, Botswana's tertiary and vocational training system is still undeveloped and produces either a low level of skills relevant to the cutting and polishing industry. Due to high unemployment, Botswana has a significant pool of unemployed workers that have generally received some education even if they have no formal training qualifications. According to data on the educational attainment of the workers in three cutting and polishing firms discussed in Section 6.1, this is the predominant level of general human capital that the industry employs. Chapter 8 will discuss the minimum education and training requirements used by the firms during their recruitment process to determine if the firms are able to recruit workers with these

minimum requirements. This will be done in Chapter 9 to ascertain whether the human capital produced in the education and vocational training system meets the needs of the cutting and polishing industry, in other words, whether the cutting and polishing firms are able to recruit workers with the general human capital that they require.

The next chapter discusses the role of industry institutes in forming industry-specific human capital in Botswana's nascent diamond cutting and polishing industry.

## **Chapter 7:**

### **Human Capital Formation in Diamond Cutting and Polishing**

#### **Industry Training Institutes**

##### **7. Introduction**

As we saw in Chapter 4, Becker (1964) argues that when industry-specific training can increase productivity in more than one firm in the same industry, firms will not pay for this kind of training as the training firm may not recover its training costs. Therefore, when human capital is general to an industry, it can be formed most efficiently in industry training institutes. As will be shown in this chapter, very little training in Botswana's cutting and polishing industry currently takes place in industry training institutes. However, over time industry training institutes could start playing a bigger role in human capital formation because, as we will see, some foundations are being put into place to increase industry training. In order to understand the role that industry training can play in the diamond cutting and polishing industry, the example of industry training institutes in India's world leading cutting and polishing industry is investigated.

In summary, this chapter describes the evolution of industry training in Botswana's diamond cutting and polishing industry, before considering the evolution of the more developed industry training in India's cutting and polishing centre. It then goes on to draw out some conclusions about the role of industry training could play in Botswana's diamond cutting and polishing industry in the future.

## **7.1.The Evolution of Formal Industry Training in Botswana's Diamond Cutting and Polishing Industry**

This section describes how industry-specific training provision and demand has evolved in Botswana's cutting and polishing industry. The development of Botswana's diamond cutting and polishing industry can be divided into three stages, which are: (1) the pre-production phase, (2) the production start-up phase and, (3) the production ramp-up phase. In the pre-production phase the cutting and polishing firms were establishing their factories in Botswana. After the firms had been issued with licenses, they had to start-up factories in Botswana<sup>25</sup> in order to receive a supply of rough diamonds from the DeBeers/government joint venture, the Diamond Trading Company (DTC) Botswana. Some acquired land and built new factories, others rented existing factory shells from the Botswana Export Development and Investment Agency (BEDIA) or private owners. During this time the firms made considerable investments, including importing and installing their equipment and machinery. For example, the human resource manager at in one of the firms stated that the firm has invested P46 million (approximately US\$7 million) to start its factory in Botswana.

While the firms set-up their factories, they also built up some local human resource capability that would be used, together with foreign workers, to initiate production during the production start-up phase. The firms recruited generally less than 50 workers and they received training for up to year until production was started in the factories. After production started, each factory, in line with their business strategies, started to ramp-up production. In this third and current phase of the industry's development, the firms have the challenge of balancing their production and training activities. Due to this challenge and the poaching externality identified by Becker (1964), one would expect some training

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<sup>25</sup> Apart from the three factories that had been established in the 1980s and 1990s.

in the industry to take place in industry training institutes. The next section explores the extent to which this has happened.

As was shown in Chapter 4, institutional training in the diamond cutting and polishing industry can take place in industry training schools, gem-testing laboratories or through management companies and equipment suppliers. The next three sections will discuss the types of training institutes that provided training to the cutting and polishing industry during the pre-production and production start-up phases and the institutes that are currently providing formal training as well as those that plan to provide training for the industry in the future.

#### **7.1.1. Formal Industry Training During the Pre-Production Stage**

This section discusses the formal training institutes that provided the firms with training during the pre-production stage of Botswana's cutting and polishing industry.

##### *Harry Oppenheimer Diamond Training School*

The first such institute to provide training was the Harry Oppenheimer Diamond Training School, which is located in neighbouring South Africa's diamond centre in Johannesburg. This city houses more than 100 diamond-related companies, that include diamond dealing companies, polishing factories, manufacturing jewellers, shipping companies and diamond equipment supply companies. The school is a joint venture between DeBeers and the Diamond Foundation of South Africa, made up of the Master Diamond Cutters Association and the Rough Diamond Dealers Association. The proximity of this training school makes it well positioned to provide training for Botswana's downstream industry.

The school offers a number of courses (see Table 7.1). The rough diamond course aims to give students a basic understanding of the properties of rough diamonds to enable them

take informed decisions about how to process them. The elementary diamond course is aimed at students who want to acquire a basic background on how to polish diamonds. The Diamond Polishing Course is for students who are either starting their career as a diamond polisher or for those who want to acquire a more in-depth background on the manufacturing of diamonds. The Diamond Grading, Gem Identification and Coloured stone courses are the practical component of the Gemmological Institutes of America's (GIA) courses, which will be discussed in more detail in Section 7.4 of this chapter. The school offers these courses to students seeking to meet the practical requirements of the GIA's Graduate Gemmologist diploma or students wanting to acquire hands-on training.

**Table 7.1: Courses offered by the Harry Oppenheimer Diamond Training School**

<i>Course</i>	<i>Duration</i>	<i>Cost (2012)</i>	<i>Qualification</i>
Rough Diamond Course	2 weeks	US\$890	Certificate
Elementary Polishing Course	2 weeks	US\$360	Certificate
Diamond Polishing Course	6 months	US\$ 3350 (SADC) US\$ 5,250 (Foreign)	Certificate
Diamond Grading Course	5 days	US\$1720	GIA letter of completion
Gem Identification	5 days	US\$1720	GIA letter of completion
Coloured Stone Grading	5 days	US\$1310	GIA letter of completion

Source: <http://diamond.co.za/dts/>

In the past, the Harry Oppenheimer Diamond Training School provided training for one firm in Botswana's cutting and polishing industry. The managing director of this firm explained that the firm had a training agreement with the school while the firm was still establishing its factory in Botswana. According to this agreement, workers would be trained in the firm for 3 months after which they would be sent to the school for further training. The firm would tell the school what training to provide the workers with and once this training was completed the workers would be sent back to the firm. He went on to explain that once the firm had set up its factory and had its own in-house training school, it

no longer needed to send workers to the Harry Oppenheimer Diamond Training School because the firm was able to provide training according to company standards for the patented ‘ideal cut’ that the firm produces.

There was no evidence to suggest that the Harry Oppenheimer School still provides training for any of the firms in Botswana’s diamond cutting and polishing industry. Other interviewed firms did not make use of industry training in the pre-production stage.

#### **7.1.2. Formal Industry Training During the Production Start-Up Phase**

This section discusses the provision of formal industry training in Botswana’s cutting and polishing industry while the companies were starting-up production in their factories in Botswana.

##### *HRD Antwerp*

Historically, Antwerp is one of the world’s most important diamonds centres, which before World War II had the biggest cutting and polishing industry. Today it is an important trading centre with about 80 per cent of rough diamonds and 50 per cent of polished diamonds passing through Antwerp every year (Even-Zohar, 2007). The Hoge Raad voor Diamant (HRD) or Diamond High Council was established over 30 years ago to provide Antwerp’s diamond industry with services and equipment, which include a reputable gem-testing lab, training programmes using its considerable in-house expertise, research and development for the industry. Although HRD Antwerp has standard education programmes such as the Diamond Grader Programme and the Gemmology Programme, it also offers tailor made programmes to meet the needs of the companies.

A number of the cutting and polishing factories in Botswana have head offices or offices in Antwerp. These are mainly involved in the sale and marketing of their polished diamonds.

However, one of these firms explained that some of its workers in its quality control department in Botswana had been trained at HRD Antwerp with advanced grading skills when production was still being started in Botswana. No workers in this firm are currently sent to Antwerp for the training. Instead, the manager explained, the workers that were trained in Antwerp are responsible for training other workers with grading skills.

None of the other interviewed firms made use of formal industry training at this stage of the industry's development.

### **7.1.3. Formal Industry Training in the Production Ramp-Up Stage**

This section discusses the role of formal industry training in the current phase of the industry's development, when firms are ramping-up their production capacity in line with their individual business models.

#### *Gemmological Institute of America*

As was discussed in Chapter 5, the Gemmological Institute of America (GIA) is a major gem-testing laboratory that developed a standardised evaluation process for polished diamonds known as the International Diamond Grading System. GIA is a non-profit institute with operations in all the major diamond centres in 14 countries. Although other laboratories, such as the International Gemmological Institute (IGI) and European Gemmological Laboratories (EGL) operate alongside the GIA in cutting and polishing centres around the world, in Botswana the GIA is the only laboratory operating. Gem testing laboratories play a very important role in maintaining the standards used to evaluate and certify diamonds in the diamond industry. The grading certificates issued by gem testing laboratories like the GIA protect the buyers and sellers of diamonds by assuring quality. These laboratories also play a key role in research and development and in the provision of education and training for the industry.



The GIA opened its branch in Botswana in 2008 and, at the end of 2009, the company employed 30 people of whom 90 per cent were locals (Interview, senior official at the GIA Botswana, Gaborone, November 2009). At the end of 2011, the company's labour force had risen to 35 employees (Government of Botswana, 2012a). The GIA provides the cutting and polishing industry with laboratory services, such as the issuing of grading certificates. Some of the firms submit their polished diamonds to the GIA laboratory to be graded and certified and some of firms chose to have their diamonds graded at laboratories in their home country due to long-standing service arrangements (Interview, manager at a diamond cutting and polishing firm, Gaborone, May 2011). GIA issues a Diamond Grading Report or a less detailed and less expensive Diamond Dossier. These reports contain information such as whether the diamond is a natural or synthetic diamond, how colour, cut, clarity and carat, were graded according to the International Diamond Grading System, and a diagram showing the location of any flaws the diamond may have. GIA Botswana only grades loose diamonds and targets the high end of the diamond market focusing on diamonds between three and four carats since the cutting and polishing factories typically need GIA certificates for diamonds bigger than one carat (Interview, senior official at the GIA Botswana, Gaborone, November 2009).

Apart from grading services, the GIA also aids the cutting and polishing industry with industry training, particularly for grading skills. Globally, the GIA offers the following diamond-related<sup>26</sup> diplomas: Graduate Gemmologist, Graduate Diamond and Graduate Coloured Stones. The Graduate Gemmologist course provides students with technical knowledge and sales skills for the entire spectrum of diamonds and coloured stones. The Graduate Diamond course provides students with expertise needed by professionals to grade, buy, and sell diamonds. Lastly, the Graduate Coloured Stones course teaches students how to identify and evaluate different coloured gemstones. Graduates of the

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<sup>26</sup> GIA offers education programmes for other precious stones like pearls.

Graduate Gemmologist diploma also receive Graduate Diamond and Graduate Coloured Stones diplomas. The GIA also offers diplomas and courses for the jewellery manufacturing industry such as the Accredited Jewellery Professional diploma, which provides students with the product knowledge and sales techniques for jewellery retailing. These diplomas are made up by a number of different programmes or modules and take 7 to 24 weeks to complete. They can be done full-time at one of 11 campuses worldwide or through long-distance learning (eLearning) with a laboratory class component. The laboratory component is also offered in Botswana as part of GIA initiative to foster downstream skills development in producer countries.

In the last decade, GIA has developed education programmes to support beneficiation initiatives in various African countries with diamond industries such as South Africa and Botswana. The CEO of GIA, Donna Baker, recently claimed:

“Education is at the heart of our mission. GIA is committed to fostering skills development through gemmological education designed to meet employer needs in these diamond producing hubs. These programmes are a driving force behind diamond beneficiation: they make it possible for regional populations to play a more active and integral role in the diamond industry, and set the stage for new employment opportunities in the future” (GIA, 2012:1).

As part of GIA’s initiatives in Africa, GIA Botswana offers the following modules (see Table 7.2): (1) Diamond Essentials, (2) Diamonds and Diamond Grading, and (3) Diamond Grading Labs course which represent some of the modules needed for the diploma qualifications, such as the Graduate Gemmologist diploma discussed earlier in this section.

**Table 7.2: Training modules offered by GIA Botswana**

<i><b>Modules</b></i>	<i><b>Qualification</b></i>	<i><b>Prerequisite(s)</b></i>	<i><b>Cost</b></i>	<i><b>Length</b></i>
Diamond Essential	Certificate	None	\$150	3 months
Diamond and Diamond Grading	Certificate	Diamond Essential	\$1,300	15 months
Diamond Grading Lab	Letter of Completion	Grading Experience	\$1,350	35 hours

Source: Fieldwork Research and GIA website

The first two modules are done through long-distance learning (eLearning) and the last module is practical and is taught at GIA Botswana by an instructor from the USA. The Diamond Essential module teaches students the basics of diamonds and the diamond grading system. The Diamonds and Diamond Grading module builds on the Diamond Essential module and teaches the grading system at an advanced level, as well how to identify synthetic and natural diamonds, and different treatments that can be used to improve the grade of diamonds. Lastly, the Diamond Grading Laboratory module provides hands-on one-to-one training on how to actually grade diamonds using real diamonds and various tools such as microscopes. At the end of this class students are tested in order to complete the course successfully.

Generally, the firms train their graders in their factories first and once they have developed the basic grading knowledge and skills they are taken to a gemmological institute, like the GIA, to complete a formal basic course in grading followed by an advanced grading course. As a manager at a firm explained,

“A worker that is sent for a gemmology course is someone who already knows grading and how to use gemmology. They are sent to sharpen their skills and fine-tune their skills.” (Interview, Gaborone, May 2011).

Since gemmological institutes are responsible for issuing the grading certificates that are demanded by final customers as assurance of the craftsmanship that went into polishing the

diamond they are buying (discussed in Chapter 4), it is important for the firms to know how the institutes will grade their diamonds. The firms can then ensure that they cut and polish diamonds in a way that achieves the best or desired grades from the Gemmological Institute. The firms in Botswana can train their graders at the local GIA or in other gemmological institutes based in other diamond cutting centres. The grading courses offered by GIA Botswana are also used by other stakeholders in the industry who need to understand how diamonds are graded, such as government officials and industry service providers. For example, the Diamond Trading Company (DTC) Botswana sends 10 employees annually for GIA's diamond grading course, which is offered four times a year in Botswana (The Gazette Newspaper, 23 February 2011).

At the time of fieldwork, GIA Botswana had just started offering its training programmes to the industry and it was therefore too early to assess the extent to which the firms make use of this industry-specific training.

#### **7.1.4. Proposed Industry Training Institutes**

Currently, GIA Botswana is the only industry training institute operating in the country. This section discusses how this could change in the future with plans to increase industry training in advanced stages of development.

##### *Indian-Africa Diamond Institute*

In 2008, India and 14 African countries held an India-Africa Forum Summit, where the Indian government committed to start the Indian-Africa Diamond Institute (IADI) at the planned Oodi College of Applied Arts & Technology (OCAAT) in Botswana. Botswana won the bid to host the IADI, a partnership between the African Union and India, beating South Africa, Namibia and Zimbabwe (Mmegi, 15<sup>th</sup> March 2011). The Government of India then appointed the Indian Diamond Institute (IDI) as the implementing agency for

the project. The IDI is a non-profit training school funded by India's Ministry of Commerce. It was established in 1978 in the heart of India's diamond industry, Surat. This school trains workers for India's diamond industry with ISO-accredited diplomas and certificates in diamond sorting, grading and processing, gemmology, jewellery designing and manufacturing, computer application, and management programmes. The IDI's campus has state-of-the art research laboratories, a library, and facilities for practical training, which is the main form of teaching in the institute. Although theoretical training is also used, the institute puts emphasis on practical training in order for the students to "develop skill and high proficiency" (The Times of India, 2012:12). The IDI's role in providing formal training in India's cutting and polishing industry is discussed in more detail in Section 7.2 of this chapter.

The institute that the IDI will open Botswana, the IADI, will be similar to its Indian institute. The aim of the institute is to not only train Botswana but also nationals from other African diamond producing countries, as part of the agreement between the African Union and the Indian government. By developing skills in sorting, cutting and polishing diamonds and jewellery manufacturing, it aims to contribute to the growth of downstream industries in African diamond producers. At full capacity the institute will train 800 students per year (Personal correspondence, senior official at the IDI, July 2011) fulltime on campus. In India, the costs of the IDI courses is subsidised by the government for locals and it is therefore likely that the government of Botswana will also subsidize the costs of training for locals.

The IADI will offer five courses (see Table 7.3): Diamond Planning, Diamond Grading, Manual Jewellery Design, CAD based Jewellery Design and Jewellery Manufacturing.

**Table 7.3: IADI's proposed courses**

<i>Course</i>	<i>Duration</i>	<i>Pre-requisites</i>	<i>Cost</i>	<i>Qualification</i>
Diamond Planning	4 weeks	Junior Secondary Certificate	US\$350	Certificate
Diamond Grading	18 weeks	Higher Secondary Certificate	US\$1000	Diploma
Manual Jewellery Design	6 weeks	Junior Secondary Certificate	US\$390	Certificate
CAD based Jewellery Design	8 weeks	Junior Secondary Certificate and knowledge of manual design	US\$475	Certificate
Jewellery Manufacturing	4 weeks	Junior Secondary Certificate	US\$480	Certificate

Source: Fieldwork Research

The Diamond Planning course teaches students the crystallography of diamonds, how to identify flaws in diamonds, the economics of diamond planning and the different techniques used to plan and mark diamonds using computerised diamond planning machines such as Sarin and Helium. The diamond grading course consists of a polishing module, grading modules and microscopic study. During the polishing module students are taught the basics of diamond polishing including how to maintain the machines used for polishing. The grading module teaches students how diamonds are graded and the instruments that are used to grade diamonds. Lastly, the microscopic study teaches students about the different flaws that diamonds can have, how to identify these flaws using a microscope, how they are plotted and how to differentiate between synthetic and natural diamonds using the various instruments available in the industry.

It is currently not clear when the IDI will start operating in Botswana, this, as well as firm responses to whether they will make use of its training once it starts operating will be discussed in Chapter 9.

#### *Afrimond Diamond and Jewellery Institute*

At the beginning of 2012 the Botswana Training Authority (BOTA) accredited two courses at the recently established Afrimond Diamond and Jewellery Institute (ADJI). ADJI was established in South Africa in 2000 and it is also establishing a school in both Botswana

and Zimbabwe. A Motswana businessman, Todd Majaye, who previously worked for Debswana, founded the ADJI. He stated that he started this school in response to the growing need for knowledge and skills among locals in Africa's diamond producing countries (Interview, Gaborone, May 2011).

Table 7.4 shows the courses offered by the ADJI. The school did not provide data on the cost of the courses. The Diamond Business Skills course is aimed at students that plan to build careers in the diamond industry, as well as current workers in the industry that do not have diamond valuing knowledge. This course teaches how diamonds are sorted in order to determine the prices of diamonds and the role that international diamonds markets play in the pricing of diamonds. It provides important skills for workers, particularly those in management positions in the industry who need know how to price diamonds.

**Table 7.4: Afrimond Diamond and Jewellery Institute (ADJI) Courses**

Course	Duration
Diamond Foundation*	5 days
Diamond Business Skills*	5 days
Diamond Sorting and Valuing	2 to 4 weeks
Diamond Cutting and Polishing	3 to 6 weeks

\* Accredited by Botswana's Training Authority

Source: Fieldwork Research

The Diamond Foundation course does not give students technical skills but instead provides an understanding of the diamond value chain. It addresses how diamonds are formed, and mined, the scientific properties of diamonds, the international structure of the diamond industry, how the industry is regulated and current trends in the industry. The aim of the course is to provide workers with the knowledge needed to address the needs and objectives of organisations (such as industry service providers) or government for effective participation in the diamond industry. ADJI's courses target all workers in the diamond

industry including government officials and employees in the diamond cutting and polishing firms (Interview, senior official the ADJI, Gaborone, March 2011). In May and July 2012, the ADJI held its first two five-day Diamond Foundation courses.

ADJI is also starting to host industry workshops aimed at bringing all the stakeholders in the industry together to discuss pertinent issues. ADJI hosted its first workshop in Gaborone in February 2012 and the institute plans to host a conference annually. The workshops also aim to provide locals with information on opportunities in the local diamond industry to foster more local participation in the industry.

#### *Diamond Manufacturing and Management Consultancy (DMMC)*

The Diamond Manufacturing and Management Consultancy (DMMC) is a subsidiary of I. Hennig & Co. Ltd, which is one of the brokering companies operating in Botswana and other diamond centres. The DMMC plans to provide wider training services to the industry through the proposed Botswana Diamond Training School. The training school plans to provide different levels of training to Botswana's diamond industry and with plans to eventually provide training to students from other diamond producing countries such as Namibia and Angola. The DMMC also plans to start Diamond Hub training, which would be a 6-month training programme for senior staff at the Diamond Hub as well as local entrepreneurs who wish to invest into the diamond industry.

#### *Indochine Botswana*

Lastly, Indochine Botswana was established in 2010 as a consultancy that mainly provides technology services to support Botswana's cutting and polishing industry. Although the company also provides management services such as financial advice to international investors, its main role is as a representative of the Israeli technology company, Sarin Technologies. Sarin Technologies is a worldwide leader in the development and



manufacturing of diamond processing machinery, such as machines used to plan and mark diamonds in preparation for production, as well as evaluation and measurement machines used for diamond grading. Sarin Technologies' machinery and equipment have become essential to maximising profits in the industry and it is widely used in manufacturing plants, gemmology laboratories, and by diamond dealers and graders. Sarin Technologies is widely used in Botswana's cutting and polishing industry and Indochine Botswana provides technical support, such as maintenance and warranty services, Sarin Technologies' clients.

Indochine is also responsible for training workers in the cutting and polishing firms to enable them to use Sarin equipment. Since technology in the cutting and polishing industry is changing rapidly, the equipment and machinery suppliers play an important training role in the industry. When new equipment and technology is introduced to the industry, the firms need to be trained in how to use the new machinery. For example, one of the firms recently introduced the latest technology Galaxy 3000 (discussed further in Chapter 9), which is used in deciding the most economic way to cut and polish a diamond (known as planning). Technicians from Sarin Technology helped the firm install the new machinery and to train workers in this firm.

#### **7.1.5. Summary: The Evolution of Formal Industry Training in Botswana's Cutting and Polishing Industry**

This section has shown that, industry training in Botswana's cutting and polishing industry at all phases of the industry's development has been very low, with only one local training institute, GIA Botswana, currently providing industry training. However, there are plans to increase industry training in a number of proposed training institutes. Since, Botswana's diamond cutting and polishing industry is still being developed it would be useful to investigate how industry training has evolved in a more developed cutting and polishing

centre. This could shed light on how human capital formation through industry training can develop over time. The next section therefore investigates the evolution of industry training in India's developed cutting and polishing centre.

## **7.2.The Evolution of Formal Industry Training in India's Diamond Cutting and Polishing Industry**

India's industry has been selected for this comparative analysis not only because it is the biggest and fastest growing diamond cutting and polishing industry in the world but also because it is similar to Botswana's industry, in that it was also started from scratch with no existing human resource pool. This is unlike traditional cutting and polishing centres, like Israel and Belgium, which started as a result of the relocation of the industry. For example, Israel's industry started during World War II when Jewish diamantaires relocated from Belgium to what was then Palestine. India's cutting and polishing industry currently processes 95 per cent of the world's polished diamonds in terms of pieces, which is equivalent to 80 per cent of the world's rough production by volume and 56 per cent by value (NSDC, 2010:8).

India's industry was started in the 1960s and was built around the processing of small, inexpensive diamonds known as near-gems. Prior to the rise of India's cutting and polishing industry, these diamonds were classified as industrial diamonds and were not polished. But the low costs of production in India made it profitable to cut and polish these types of diamonds into gems. Before India's cutting and polishing industry developed, global diamond production was sorted into 20 per cent gem and 80 per cent industrial diamonds. However, it is now sorted into 20 per cent gems, 45 per cent near-gems and 35 per cent industrial diamonds (Even-Zohar, 2007:630). While the older cutting and polishing centres, like Belgium and Israel, mainly process larger, higher value diamonds in

excess of 0.5 carats, India mainly processes smaller, lower valued diamonds (NSDC, 2010).

Today, India not only specialises in the manufacture of small diamonds as the country is currently increasing its competitiveness in larger diamonds as well (FRIDGE Report, 2005). India's industry started in rural communities, with a small-scale informal cottage industry mainly in the Gujarati community and over time a more formal large-scale industry developed (Interview, founder of a diamond cutting and polishing firm, Mumbai, May 2011). India's informal sector plays a major role in the country's thriving cutting and polishing industry, which employs between 800,000 and 1 million workers, with 65 per cent of the workforce employed in the informal sector (Even-Zohar, 2007:636-7). Rao and Bhatnagar (2009:88) describe India's diamond cutting and polishing industry as follows:

“The industry resembles a close-knit community that thrives in the atmosphere of secrecy and informality that enveloped the diamond trade. A majority of India's skilled workforce is employed by small family owned firms or units that process diamonds on a job-lot basis.”

According to Even-Zohar (2007), India's cutting and polishing firms can be divided into large, medium-sized and semi-organised operations. The large factories employ over 250 workers, are professionally managed and are typically owned by exporters. Medium-sized factories employ between 100 and 250 workers. They are primary contractors with links to exporters. These large and medium sized factories represent 25 to 30 per cent of all diamond manufacturers in India. The last and largest group, the semi-organised units, is mainly part of the informal sector. These factories generally employ fewer than 100 workers, are less professionally managed and are mainly secondary or tertiary contractors. Production in the industry is organised such that “the large export houses will do the initial

marking, preparing, laser sawing or cleaving of the diamonds and then pass the goods on to contractors and subcontractors for polishing” (Even-Zohar, 2007:637). In this way the large factories concentrate on parts of the process that are most skill intensive, whilst the contractors concentrate on activities that are least skill intensive and most labour intensive. Surat is the main cutting and polishing manufacturing hub within India, manufacturing 45 to 50 per cent of the country’s entire manufacturing output. The industry is administrated and controlled from Mumbai, where diamonds are mainly traded and exported.

### **7.2.1. The Start of Formal Institutional Training in India’s Industry**

Formal institutional training in India’s cutting and polishing industry started in the 1970s. Before formal training was available locally, it could be sourced from the older cutting centres like Belgium. A founder of diamond cutting and polishing firm in industry said, “It was the government that drove the start of formal training in India’s diamond cutting and polishing industry” (Interview, Mumbai, 23<sup>rd</sup> May 2011). India’s diamond industry is coordinated and governed by the Gems and Jewellery Export Promotion Council (GJEPC), which was set up by the Ministry of Commerce and Industry in 1966. The government’s training initiatives, through the GJEPC, led to the establishment of the Indian Gemmological Institute (IGI) and Indian Diamond Institute (IDI)<sup>27</sup> in 1971 and 1978, respectively. The government established these institutes to increase the industry’s competitiveness in larger diamonds by training the existing industry employees in the latest technology to upgrade their skills (FRIDGE Report, 2005).

The IGI and IDI are non-profit organisations that are funded by India’s Ministry of Trade and Industry. The IGI provides the diamond industry with formal training, conducts gemmological research and development, as well as providing gemmology services such the issuing of grading certificates. The IDI’s focuses solely on the provision of training

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<sup>27</sup> The Government also supports the Institute of Gem and Jewellery that provides training to the jewellery manufacturing industry.

services for the industry, offering courses for all downstream industries (cutting and polishing, jewellery manufacturing and trading). To promote more formal training in the industry, the Indian government subsidises the costs of training programmes offered by the IDI and IGI. As discussed in Section 7.3, the IDI plans to provide training in Botswana through the India-Africa Diamond Institute (IADI) as a result of an agreement between the African Union and India. The IDI offers similar courses to those proposed by IADI in Botswana's cutting and polishing industry. Other private gemmological institutes such as the GIA (discussed in Section 7.2) and the International Gemmological Association (IGI) also operate in India and provide training to the industry, particularly in grading skills.

### **7.2.2. The Extent of Formal Institutional Training in India's Industry**

Despite the government's concerted effort to start formal institutional training in India's diamond industry, the level of formal institutional training in the industry is still low. Formal industry institutional training tends to be higher amongst larger firms. By May 2012, the IDI had trained only 25,000 students in the field of diamonds, gems and jewellery since its inception in 1978 (Times of India, 11<sup>th</sup> May 2012). This is a relatively small number given that India's industry employs up to a million workers. Furthermore, according to data collected by India's National Skill Development Corporation (NSDC), the majority of those employed in the cutting and polishing industry have not received any formal industry training. The NSDC private-public partnership was set up in 2008 to promote skills development through vocational training. As part of its mandate it has mapped skills gaps until 2022 in 20 of India's high growth sectors. The NSDC's research found that the highest level of education received by 75 per cent of the cutting and polishing industry's labour force was below standard 10, which is equivalent to 10 years of schooling, and that less than 4 per cent of the labour force had received a diploma or completed a vocational training course (NSDC, 2010, 23). Indian diamond dealers Jha and

Tomar argue in their book *Diamond Education* that formal training needs to increase in India:

“Particularly in India education is essential in the field of diamonds. Domestic and international institutes are already here to impart professional education in the field of gems and jewellery. But, this is not enough. We need to do something more in terms of exploring the real potential of [the] Indian diamond industry by increasing our efforts towards spreading formal education”(2007:34).

To get an understanding of the role of industry training in India’s cutting and polishing industry, representatives of three cutting and polishing factories were interviewed during fieldwork. For the purpose of this analysis, these factories will be called Factory 1, Factory 2 and Factory 3. Factory 1 was a medium-sized factory with less than 300 employees, while Factory 2 and 3 were very large factories with over 3,000 employees. The two larger firms tend to employ experienced workers who previously worked for a small or medium-sized firm or have received formal training. These findings are in line with the NSDC findings, which found that workers trained through training institutes like IDI and IGI will typically work with larger companies (NSDC, 2010: 19). All three firms interviewed said that for jobs like polishing they do recruit workers who have been trained by IDI but that they also recruited experienced workers who did not have formal training. With regards to grading jobs, the firm responses varied. Factory 2 and 3 stated that they only hire graders with experience and formal training. As the general manager at factory 3 explained, “We only recruit skilled workers, they must have at least 8 years experience. We do not recruit “freshers”; they must first get trained and experience before they come to us” (Interview, 19<sup>th</sup> May 2011).

The production manager at Factory 1 said that it did hire workers with no formal training or experience and that the only formal training that the firm undertook was for their graders.

“Formal training is done for graders only once they have received sufficient experience, only the best sorters become graders. It takes 5 to 6 years in sorting department before you can become a grader. There is a government sponsorship programme for training graders. Our graders are trained by the IGI. They are taught how to look at a stone with the GIA standards and grade it” (Interview with Factory 1, Mumbai, 22<sup>nd</sup> May 2011).

So it seems that some years of experience need to be acquired before graders are sent for a formal training in India. Due to the relatively high cost of the courses offered in India, which can be between £300 and £600, the majority of the low skilled workers are unable to sponsor themselves for formal training (NSDC, 2010: 46). This has resulted in a low level of formal training in India’s cutting and polishing industry. So “even though there are training institutes [in India], there exists scope to broaden the scale and scope of training – in terms of skill sets and number of persons trained (NSDC, 2010: 46).

### **7.3.Conclusion: Future Prospects for Formal Industry Training**

International experience from India shows that the development of industry training institutes can result from government initiative. India’s industry is competitive and mature but industry training has been driven by the government. In Botswana’s nascent industry, overall firm utilisation of formal institutional training during all three phases of development was very low. Amongst the 12 interviewed firms, only 5 firms stated that they had made use of formal institutional training (see Table 7.5). Apart from Firm 4, all the firms that utilised formal institutional training, sought training for their graders from

gem testing labs. Firm 4 is the only firm that sourced formal institutional training for basic processing skills.

**Table 7.5: Firm utilisation of industry institutional training**

<i>Firm</i>	<i>Pre-Production Phase</i>	<i>Production Start-Up Phase</i>	<i>Production Ramp-Up Phase</i>
<b>Firm 3</b>	Harry Oppenheimer Training School	HRD Antwerp	
<b>Firm 4</b>			
<b>Firm 6</b>			GIA Botswana
<b>Firm 8</b>			GIA India or GII (India)
<b>Firm 9</b>			GIA Botswana

Source: Fieldwork Research

In February 2011, the Botswana Training Authority (BOTA) accredited GIA's grading laboratory course. BOTA, as discussed in Chapter 6, is a parastatal under the Ministry of Labour and Home Affairs that was established in 2000 as a result of the Vocational Training Act of 1998. Its mandate is to reform, operationalise and monitor Botswana's vocational training system. As part of its role in coordinating the development of quality vocational skills in Botswana, it accredits training programmes according to global standards. Companies in Botswana registered for value added tax (VAT) pay a training levy and the amount of paid depends on company turnover. This money is then used to give firms training rebates when they train workers either in the firm or outside the firm in accredited training programmes. The government has exempt the firms in the cutting and polishing industry from paying the training levy in order to fast track human resource development in the industry. So firms are not able to get training rebates, as they do not pay the training levy. When fieldwork was done in March – May 2011, only two firms stated that they sent their graders to the local GIA for training, while one firm stated that it sends its graders either to the GIA in India or to the Gemmological Institute of India (GII) for formal training. As this was only a few months after the local GIA course was accredited by BOTA, local demand could have increased since then.



Based on current plans for the establishment of more training schools one would expect institutional training to increase in the future. However, since industry training is still in its infancy it is too early to judge its effectiveness. Chapter 9 will assess the level of interest for formal industry training, in order to understand the role that industry training could play in Botswana's diamond cutting and polishing industry. Before this is done, the next chapter discusses the role of the firms in the formation of human capital in the industry.

## **Chapter 8:**

### **Human Capital Formation in Diamond Cutting and Polishing**

#### **Firms in Botswana**

##### **8. Introduction**

This chapter analyses the production of human capital within the diamond cutting and polishing firms in Botswana. It describes the general nature and characteristics of training that takes place in the firms and assesses the creation of production and non-production human capital. This chapter also investigates whether the firms use different strategies to mitigate the loss of workers to other firms within and beyond the industry in order to protect their human capital investments. As discussed in Chapter 4, Becker (1964) argues that when firm training is in transferrable industry-specific skills it will result in a poaching externality in the industry's labour market since these skills can raise productivity in other firms in the industry. He suggests that these skills are produced most efficiently in industry training institutes. However, in Chapter 7 we found that institutional industry training is still embryotic in Botswana's nascent cutting and polishing industry. This means that firms have to do much of the necessary training themselves and it is therefore important to understand any strategies they may use to prevent the loss of workers to other firms. In other words, it is important to consider whether firm training is a case of firms training in a sub-optimal industry training environment due to an immature industry training system.

The first section of this chapter discusses the process of training in the firms for both production and non-production workers. This discussion includes how firms recruit their workers, both trainees and trainers, and how the actual training takes place in the firms. Then the chapter investigates the various strategies used by firms to mitigate the loss of workers to other firms within and beyond the industry. The last section concludes with the

chapter's findings on human capital formation in the firms, particularly the findings on the effectiveness of the different firm strategies at mitigating the loss of workers.

### **8.1. The Development of Human Capital in the Firms**

As was shown in Chapter 7, there is still a low level of institutional training in Botswana's cutting and polishing industry. Furthermore, Chapter 6 showed that the vocational training system does not produce an adequate number of general technical skills required in some production operatives like laser technicians. These general technical skills are useful to the cutting and polishing industry as well as firms in other industries that employ laser technology. Thus this section investigates the extent to which some of the training that the firms provide their workers is industry-specific training. The section starts with a general description of how the formation of human capital takes place in the firms. The findings are based on interviews with representatives of 12 of the 16 firms that were operating in Botswana at the time of fieldwork (see research methodology in Chapter 3).

Employment has been growing in the industry since the government signed a new agreement with DeBeers in 2006. In 2004, before the agreement, the industry's four factories only employed 650 people (Gaolathe, 2005). However, by April 2011, the number of factories had increased to 16 and employment had increased to 3170 workers (see Table 8.1). Botswana's cutting and polishing industry has therefore created significant employment, representing almost 10 per cent of employment in the manufacturing sector.

**Table 8.1: Employment breakdown in the interviewed firms**

Firms	2008 Pre-Crisis Employment		2009 Post-Crisis Employment		April 2011				
	Total	Percentage of Locals	Total	Percentage of Locals	2011 Employment	Percentage of Production Workers	Number of Production Workers	Percentage of Local Employment	Number of Locals Employed
<b>Firm 1</b>	206	-	103	90.3	186	76.3	142	88.2	164
<b>Firm 2</b>	550	-	318	95.3	474	67.9	322	96.6	453
<b>Firm 3</b>	-	-	-	-	235	63.8	150	86	202
<b>Firm 4</b>	-	-	-	-	56	57.1	32	83.9	47
<b>Firm 5</b>	360	-	201	90	272	68.4	186	86	234
<b>Firm 6</b>	293	88.7	246	81.3	240	64.6	155	90.8	218
<b>Firm 7</b>	90	80	60	80	119	60.5	72	90.8	108
<b>Firm 8</b>	-	-	-	-	178	66.9	119	83.7	149
<b>Firm 9</b>	170	-	125	95.2	143	79.7	114	93.7	134
<b>Firm 10</b>	-	-	-	-	136	69.1	94	73.8	100
<b>Firm 11</b>	-	-	-	-	331	63.4	210	85.8	284
<b>Firm 12</b>	-	-	-	-	116	68.1	79	93.1	108
<b>Total</b>	<b>3300</b>		<b>2200</b>		<b>3170</b>	<b>66.3%</b>	<b>2101</b>	<b>88.6%</b>	<b>2810</b>
<b>Average Firm Size</b>	<b>278</b>		<b>176</b>		<b>207</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>

Source: Data for pre and post-crisis firm employment data from fieldwork research, employment totals and April 2011 data obtained from a government agency. Table by author. Total row includes all firms in the industry, not just those that were interviewed.

The only time employment dropped in the industry was as a result of the financial crisis in the last quarter of 2008 that led to a reduction in the global demand for diamond jewellery. Demand for diamond jewellery fell particularly in the USA, which at the time accounted for 50 per cent of the global demand for diamond jewellery. The fall in final demand affected production throughout the entire diamond value chain. Diamond production fell, with producers like Botswana suspending mining as discussed in Chapter 2. The Diamond Hub estimates that prior to the recession in 2008, about 3300 jobs had been created in the 16 cutting and polishing firms and that this decreased to about 2200 jobs in 2009. In the wake of the recession, 11 of the factories were still operating at the end of 2008 and the 6 of these that were interviewed retrenched a significant proportion of their workers as a result of the crisis. For example, Firm 1 employed 206 workers at the end of 2008 and by the end of 2009 this had halved to 103 workers. The average firm size fell from 278 workers before the crisis to 176 workers after the crisis. In 2011, total employment in the industry had risen to 3170 and average firm size had increased to 207 workers as demand for diamond jewellery particularly in China, India and Russia started to recover. As the demand throughout the value chain improved, firms started to rehire workers. For example, although employment in Firm 1 had not risen to its pre-crisis level by April 2011, it had increased significantly to 186 workers, just 20 workers short of its pre-recession total of 206.

In 2011, the majority of workers employed were employed in production jobs, with production workers representing 66 per cent of the industry's total employment. In the same year, the overwhelming majority of workers were locals, with locals accounting for 87 per cent of the industry's employment. However, this varies at the firm level. Local employment as a proportion of total employment varies from 96.6 per cent in Firm 2 to 73.8 per cent in Firm 10. This variance is due to the different business strategies pursued by firms. Firm 2 uses a more labour intensive business strategy, focusing on smaller

diamonds and mass production, which has resulted in more employment for locals. In contrast, Firm 10 pursues a more capital intensive business strategy with a greater degree of automation, thus creating relatively less employment and requiring more technological capabilities, which has resulted in proportionally less employment of locals. The proportion of workers that are employed in production jobs also varies across firms, for example in Firm 9 close to 80 per cent of workers are in production jobs compared to 57 per cent of workers in Firm 4. This is due to the firms being at different phases of development. Firm 9 started production in 2007, whilst Firm 4 only started production in 2009. Hence in April 2011, Firm 9 was further along its production ramp-up phase than Firm 4.

#### **8.1.1. The Development of Human Capital for Production-Related Jobs**

This section discusses the nature and type of training taking place to develop human capital required in production jobs. As discussed in Chapter 6, the majority of workers in Botswana's labour force leave the education system with only a basic education, so they go into the firms needing both, industry- and firm-specific. According to Becker's (1964) theoretical framework for human capital formation, outlined in Chapter 4, industry specific training is best provided in specialised industry training institutes, whilst firm-specific training can take place most efficiently in the firms. As shown in Chapter 5, production workers need a considerable amount of technical expertise to cut and polish diamonds properly, impacting on the type of training these types of workers need. Since cutting and polishing diamonds is a craft, these workers need to mainly learn by doing.

In 2006, when the agreement between the government and DeBeers was signed, Botswana had no existing pool of workers with cutting and polishing skills, apart from those employed in the four cutting and polishing firms that were established before the agreement with DeBeers in 2006. So the new firms had to train workers with no existing

cutting and polishing industry training. The biggest challenge that the firms have is to balance their training and production functions. The firms' core competency is their production expertise but due to the nature and age of Botswana industry the firms need to invest a proportion of their operating budget, which could be used for production, into training. The proportion of their total operating expenses invested into training, and the challenge of balancing production and training, were greater when the factories were still new and production capacity had not been established.

But over time, as human capital has increased in the firms, they could make relatively smaller investments in training and invest more of their operating budget into production. In order to understand how the firms made human capital investments over time, Table 8.2 shows the research findings on the different aspects of training in the 12 firms that were interviewed, which include the recruitment methods used by the firms, the length of training and the firms' minimum education requirements. The data contained in the different columns of Table 8.2 will be used to frame the discussion in the rest of this section. To understand how these firms make their investments in human capital, the rest of this section discusses the characteristics of firm training, starting with the minimum education and training requirements demanded by the firms.

**Table 8.2: Firm Data on education requirements, length of training and recruitment methods for production workers**

<b>Firms</b>	<b>Minimum Education Requirement</b>	<b>Length of Initial Training</b>	<b>Recruitment Methods for Local Trainees</b>	<b>Percentage of Local Workers</b>	<b>Local Trainers/Supervisors</b>	<b>Recruitment Methods for Expatriate Trainers</b>
Firm 1	Junior Secondary	3 to 4 months	Informal	88.2%	Yes	-
Firm 2	Primary or Junior secondary	6 months	Formal	96.6%	Yes	Internal
Firm 3	No Education Requirements	6 months	Informal	86%	Yes	Internal
Firm 4	Senior Secondary	3 months	Informal	83.9%	Yes	Internal
Firm 5	-	-	-	86%	Yes	-
Firm 6	-	6 months	Informal	90.8%	Yes	-
Firm 7	Senior Secondary	6 months	-	90.8%	Yes	Internal
Firm 8	Junior or Senior Secondary	3 months	Formal	83.7%	Yes	Internal
Firm 9	Senior Secondary	7 months	Informal	93.7%	Yes	Internal
Firm 10	-	-	Informal	73.8%	Yes	Internal
Firm 11	Junior or Senior Secondary	6 months	Informal	85.8%	Yes	External and Internal
Firm 12	Junior Secondary	1 year	Informal	93.1%	Yes	Internal

Source: Fieldwork Research. Not all the data for all the firms was obtained during the interviews.



### *Minimum Education and Training Requirements*

The minimum education requirements for the majority of production-related jobs such as polishers, bruters, and sawyers are low (see Figure 5.2 for an explanation of the manufacturing process discussed in Chapter 5). These jobs represent the greatest proportion of production workers employed in the factory. This is because the majority of the human capital needed to cut and polish diamonds is practical and is developed through practice (as shown in Chapter 5). As Table 8.2 shows, the minimum education requirement for production workers in the 12 firms that were interviewed varied, one firm required primary education, five firms required junior secondary school, 3 firms required senior secondary, whilst one firm stated that it did not have any education requirements for most production workers. The technical director at this firm, Firms 3, (see Table 8.2) said:

“We have no education requirements for workers in the factory, except for technical jobs in the factory, like in Information Technology, because cutting and polishing diamonds is a creative job that requires talent, and good hand and eye coordination, so it is either you have it or don't” (Interview, 13<sup>th</sup> May 2011).

The firms' low education requirements show that even when workers have secondary school education they still need to be trained in the new skills that they need to do production jobs. The firms recruited workers from Botswana's large pool of largely unemployed low-skilled labour. As discussed in Chapter 2, unemployment is a problem in Botswana with 31 per cent of Botswana's labour force being unemployed in 2006, that is 248,812 people. This is a significant number of people considering that the country's population is only 1.9 million. Furthermore, as was discussed in Chapter 6, amongst the unemployed, 83 per cent or 207,384 had some education (primary, junior secondary or senior secondary) and 62 per cent or 153,672 had a basic education (10 years of schooling). So the firms have a large pool of workers to recruit from and they have been

able to use a process of trial and error to find the right workers for their firms. For example the Managing Director at Firm 9 said,

“I have just employed 15 people and I know that I will lose at least 5 of these workers after 3 months. I recruit small numbers of workers at a time and I have to interview about 30 workers to get 10” (Interview, 23<sup>rd</sup> May 2011).

When the firms recruit workers, the most important quality they look for is personality, or as the Managing Director at Firm 4 said,

“We also look at the personality and character of the worker, and this is trial and error. We source workers from a pool of students who have completed high school and are jobless” (Interview, 16<sup>th</sup> May 2011).

The firms also look for a worker who shows prospects of learning the craft, as the Human Resource Manager at Firm 8 explained,

“No previous training is required for production jobs just O levels [senior secondary] or Form 3 [junior secondary]. What we look for is personality, someone who is highly trainable, with high concentration and the ability work under pressure” (Interview, 26<sup>th</sup> May 2011).

This worker has to be someone who will take pride in their work and will strive towards perfecting the art needed to cut and polish diamonds, as the managing director at Firm 9 puts it,

“You need someone who is a perfectionist, someone who is accurate. I am also a perfectionist and I need someone who is disciplined enough to fix a line 100 times until it is perfect. I also need someone who is a good personality fit, just like any job. I also need someone with communication skills, they must talk, ask questions”

Thus when the firms recruit workers, the personal attributes are more important than their education attainments. Furthermore, the firms have a large pool of workers from which to source workers with the right qualities and personalities for the jobs. The recruitment methods used to identify these workers will be discussed later in this section, before this is done, the next section describes the duration training in the firms.

#### *Duration of Firm Training*

The length of the training given to production workers in the 12 firms that were interviewed varied from 3 months to one year (see Table 8.2), with most firms (5 of the 10) stating the length as 6 months. Training takes place either in separate in-house training schools or in the factory. The on-the-job training generally has both a theoretical and practical component. During theoretical training, workers are taught how rough diamonds are formed, their properties and how they need to be polished to achieve the firm's standards. The Human Resource Manager at Firm 8 said,

“Training starts with rough diamonds, what they are etcetera, you start with the basics so that they [the trainees] know the story of diamonds” (Interview, Gaborone, May 2011)

After the theoretical training, the workers receive practical training. This goes on for considerably longer than the theoretical component. The firms generally teach the new

trainees theory for only a week to a month, depending on the firm. In explaining why the practical training is emphasised more than theoretical training, the Technical Director at Firm 3 said,

“Workers have to be trained on-the-job because diamond knowledge is practical. The theory helps build a foundation but it is only through the practical accumulation of cases that you can develop the skills” (Interview, Gaborone May 2011).

During practical training the workers are familiarised with the equipment used in the manufacturing process, how to use the equipment, and how to do routine maintenance on the equipment. The firms then generally start training the trainees using industrial diamonds or boarts, which are low value diamonds that are usually crushed to make diamond powder for use on polishing wheels and other equipment. The Production Manager at a Firm 8 said,

“For one and a half to three months they [the trainees] start working with boarts and they polish them from beginning to end” (Interview, Gaborone, May 2011).

Some firms start workers immediately on gem diamonds after they have completed the theoretical training. The Managing Director of Firm 9 said,

“The first week is theory, then they start polishing straight away on diamonds” (Interview, Gaborone, May 2011).

The trainees are taught how to cut and polish diamonds by experienced trainers through on-the-job training, which is one-on-one training that involves the trainees shadowing the experienced workers. The trainers are experienced master craftsmen who play a very crucial role in on-the-job training. The trainers will be discussed in more detail later in this section. The trainee observes the skilled worker whilst they work and gradually participates by imitating what is being done. As a technical director at Firm 3 explained, “There is not much talking in diamonds because it is about imitation, you learn by imitating” (Interview, Gaborone, 23<sup>rd</sup> May 2011).

To gain knowledge and understanding, the trainees ask questions on what is being done but the actual skill is developed as they imitate the trainers. Since no two diamonds are identical, the more diamonds the worker has dealt with, the more experienced and skilled the worker will be at their job. This means that the workers continue to learn beyond the initial training period as they gain more experience in the firm. As a technical director at a firm explained, “You are perpetually learning and gathering information...” (Interview, Gaborone, May 2011).

To become a master craftsmen or women the workers need to “pass many diamonds under their loupe” (the magnifying tool used to examine diamonds) (Interview, Managing Director at Firm 9, Gaborone, May 2011). The level of craft needed by a worker depends on the size and types of diamonds that they work on. Workers need a higher level of skill to polish bigger, more valuable diamonds and they need relatively less skill to polish smaller, less valuable diamonds. When the Managing Director of Firm 9 was asked how long it takes to learn the polishing skills he said:

“On average it takes 5 to 7 years to learn the skill from scratch but this depends on the type of stones. So this would be for a general [average sized] stone.”  
(Interview, Gaborone, May 2010)

All the production workers, apart from graders, are generally given only in-house training. It was shown in Chapter 7 that graders need a particular set of industry-specific skills that are standardised by the gemmological laboratories and can be learnt in specialised training institutes. Graders need to understand the grading methods used by gemmological laboratories to examine the craftsmanship that went into the polished diamonds when they issue grading certificates. As was discussed in Chapter 7, once graders have gained enough experience, they are often sent for formal grading courses at a gemmological laboratory, some of which are laboratory classes, so that they can learn the latest methods, criteria, and technology used by the laboratories to examine diamonds.

In the cutting and polishing firms that were interviewed, production workers are generally trained to specialise. Even though they may be trained initially in different sections of the manufacturing process, their best skill will be identified during training and they will specialise in this process. As the Production Manager of Firm 8 explained:

“The workers will specialise, you see their work on a daily basis and they can ask questions if they have any. You see what he adapts well to, so they [the workers] select their specialisation” (Production Manager, Firm 8)

The types of production jobs in which it is particularly important to be specialisation are cutting, bruting and polishing. Indeed, polishers can specialise in just one type of facet. Firms train some workers to specialise in order to maximise their productivity. By

repeating a process, these workers will become more efficient in that particular task. As the Managing Director of Firm 9 said

“To get the most productivity out of the worker it is important for them to do what they are best at, so you need to find a worker’s best skills” (Interview, 26<sup>th</sup> May 2011).

In contrast, the quality control workers need to thoroughly understand all the different manufacturing processes in order to know which process to send a diamond to if it needs to be corrected. According to the Technical Director of Firm 3, the workers in the quality control department need to understand all the process in order to gain the right knowledge for their job:

“The quality control department checks that after each stage the expected yield is still on the right track. The workers in the quality control section have been trained in every section of the polishing, so that then they can make decisions about the stone” (Interview, Gaborone, May 2011).

As explained in Chapter 5, quality control is a firm-specific process that takes place at different times during manufacturing to ensure that diamonds are polished according to the plan decided by the planners and markers at the initial stage of processing.

The costs of training for the firms includes the trainers, the lost production capacity when resources are used for training instead of production, and the materials used for training, which include real diamonds. Although the trainees generally start working on industrial diamonds, called boarts, they eventually get trained on real diamonds and any mistakes they make can be a considerable cost to the firms. Furthermore, some workers fail training,

as a production manager at a firm explained, “[...] 10 to 15 per cent fail training. So you have to adapt” (Interview, Gaborone, May 2011).

If workers pass their training, they will enter a probation period, which is between 3 to 6 months depending on the firm. The workers performance will be assessed during and after this period and if the firm is satisfied, then their employment will be confirmed. If the firm is not satisfied with the worker’s performance, the probation period can be extended at the firm’s discretion. The Managing Director at Firm 9 said,

“I put them on probation for 3 months because I want to retain top workers not mediocre workers. After three months I can extend the training for another 3 months to make sure of their abilities” (Interview, May 2011).

Trainees on probation earn less than permanent workers, so workers have an incentive to work at improving their skills in order to earn a higher remuneration. In order to understand how the firms go about identifying workers that show an ability to learn the required skills, the next section discusses the methods used by the firms to recruit local trainees.

#### *Recruitment Methods for Local Trainees*

The firms recruit workers using either formal or informal methods. With formal methods the job is advertised in the national media, mainly newspapers. The Human Resource Manager at Firm 8, which uses formal recruitment procedures, said,

“When more capacity is needed in the firm, the job is advertised internally depending on the position. If a suitable candidate is not found in the firm, the job is then advertised externally in newspapers. Once applications have been



received, the company shortlists 3 to 5 candidates [for each post] (Interview, Gaborone, May 2011).

When the firms were starting their factories in Botswana, the vacancies for the first workers to be recruited were advertised in the national media. However, once the firms started production, their recruitment generally involved more informal recruitment methods. Informal recruitment methods involve current employees recommending applicants or applicants responding to simple adverts placed outside some of the firms' premises (see Figure 6.1). Only two firms of the 12 interviewed used formal methods to recruit workers, with the rest using informal methods. Informal methods, particularly when current workers recommend applicants, are preferred by most firms. As the Managing Director at Firm 9 explained,

“I do not hire workers off the street, I only recruit people who current workers have recommended, like a friend or cousin, because I know that I can trust them to not steal diamonds from the company (Interview, 10<sup>th</sup> November 2009).

Since diamonds are very expensive, the firm needs to minimise the risk of workers stealing them and recruiting workers known to existing employees is often seen as an effective way of ensuring trustworthiness. This method of recruitment believed to deter potential theft as it places social pressures on the workforce to be reliable and honest. However, some of the firms do hire workers “off the street”. For example Figure 8.1 shows a series of photos that illustrates an informal recruitment method used by one of the firms. The first picture shows a sign advertising a job for vacancies for trainee diamond polishers, which permanently affixed to the factory fence. The two other pictures show an applicant

submitting their job application to the security guard through the fence. This firm processes applications at all times.

**Figure 8.1: An example of an informal recruitment procedure in a firm**



Source: Author's research

Generally, the firms assess shortlisted applicants by using a number of different selection tests, including an oral interview. The Human Resource Manager at Firm 8 said,

“Once applicants have been shortlisted the managing director and I would interview the workers. Sometimes the production manager would also be present at the interview because we want to include him in the process (Interview, Gaborone, May 2011).

If a worker passes their oral interview and is therefore found to be a possible fit for the job, they undergo further selection processes, which include written tests and medical examinations. These tests are done to assess the suitability of the workers personality and attributes for the job, such as concentration and dexterity. When asked how they were interviewed, a quality control worker at a Firm 3 who had been working for the firm since it started five years ago said,

“When I was interviewed I felt that they wanted to know about me. After the interview, I was asked to fill in a questionnaire that asked questions about me, then I had a lie detector [polygraph] test, a medical exam and a maths test that included questions on shapes. In total there were five interviews and the last one was oral” (Interview, Gaborone, May 2011, author’s translation from Setswana).

The written tests are done to determine a worker’s knowledge of basic geometry principles. For example, a question may ask workers to draw two parallel lines in the space provided, or state the number of sides on a triangle. The polygraph tests determine whether the firm can trust the applicants. The firms also ask applicants to submit a police clearance report to ensure that they do not have a criminal record.

The first local workers to be recruited were crucial as they, together with their trainers, were responsible for starting production in the new factories. The first sets of workers to be trained by the firms were trained outside the country due to a lack of local capacity. These workers were trained either at the parent company’s existing factory in another diamond cutting and polishing centres such as, India, South Africa or Thailand or at industry training schools in these countries. For example, in 2007, one of the firms sent 45 workers to be trained for a year at its factory in Thailand and 10 workers from this initial group were still employed in the firm four years after the firm started production in Botswana in 2008. The rest had left the firm because of better opportunities or because they had been mediocre workers but it is not clear if any of the workers who left went on to work for other diamond cutting and polishing firms (Interview, Technical Director at Firm 3, Gaborone, May 2011). In 2006, another firm sent 12 workers to its factory in South Africa for a year’s training before its factory started production in Botswana in 2007 (Interview, Corporate Manager at Firm 7, Gaborone, November 2009). As discussed in Chapter 7, one

firm sent their first group of workers to South Africa's Harry Oppenheimer Diamond Training School for a year's training whilst their factory was being started.

Once production had been started in the newer firms, they continued to recruit locals for production jobs in line with their production needs. Over time the firms have been scaling up their production to levels in line with their different production strategies. Since fieldwork was mainly done during the production ramp up phase, the firms were generally still training new workers, with trainees representing a notable proportion of the firms' labour force. For example, the Corporate Manager at Firm 7 explained that at all times about 10 to 15 per cent of their staff consists of trainees (Interview, Gaborone, 21<sup>st</sup> June 2010).

In order to understand how the firms recruit expatriate trainers, the next section discusses the methods used by the firms.

#### *Recruitment Methods for Expatriate Trainers*

Trainers are a very important determinant of the human capital formed in the firms. It is crucial that the firms have the right trainers, as the way they train will determine the level of skills in the production workforce. As the Managing Director at Firm 9 explained,

"The most important components of training are: firstly, the commitment of trainers, the need to want it [the training] to happen, fifty per cent of the job [training] is done if the teacher teaches; secondly, how it [the training] happens; and, thirdly, the commitment of the trainee. You cannot bring the wrong people to come here and teach. The older teachers, who are over 60 years, were taught the skill by their fathers or uncles, and because the person was a close relation he taught them everything he knew. These older trainers

that were taught in the traditional way will teach like a grandfather. A younger teacher has no reason to teach, the older teacher has nothing to lose from teaching. The younger teacher will still be thinking about their career" (Managing Director, Firm 9).

Since training depends to some extent on the individual trainer, there are variations in the human capital developed in the different firms since they use different trainers who in turn use different training methods. The trainers are experienced master diamond cutters and polishers from other diamond cutting and polishing centres. The government, through the Diamond Hub office, assists the cutting and polishing factories to obtain work permits for foreign trainers by liaising with the Department of Immigration. As the skilled expatriates working in the cutting and polishing firms bring a scarce skill they are exempted from the full requirements of residence and work permits. Generally, the firms recruit their trainers from their operations in other diamond cutting and polishing centres. When asked why their company only recruited trainers internally the Managing Director at Firm 8 said,

"These are not contractors but they are people from our Group of Companies. So they understand the culture of our organisation..." (Interview, 18<sup>th</sup> March 2011).

This sentiment was expressed by a further 7 of the 12 interviewed firms who also only used staff from inside their company as trainers. Only one firm said it had recently started recruiting trainers from outside the company because these trainers were cheaper than the in-house trainers that the company had previously recruited. This shows the importance of firm-specific routines in the skills set required by production workers. Since internally recruited trainers understand a firm's routines, they are better positioned to train workers in that firm.

### *Local Trainees*

All of the 12 firms interviewed stated that they already had local supervisors in different sections of the manufacturing process. Their responsibilities include training other locals. For example a local quality control supervisor at Firms 3 said,

“There are many local trainers, I have also trained many people. The [local] supervisor in Table Smoothing was trained by me and in the Treatment Department I trained six [local] people” (Interview, 21<sup>st</sup> May 2011).

It would appear that as locals are developing skills, they are starting to become trainers themselves. Therefore it can be expected that over time the proportion of expatriate trainers in the industry should decrease.

### *Accreditation and the Standardisation of In-House Training Programmes*

To date, only three of the 21 cutting and polishing firms have had their training programs accredited by the BOTA (see Table 8.3). The low level of accreditation of training programmes in the industry could be linked to the costs of registering with BOTA. For example Firm 12, which did not have accredited training programmes stated the costs and difficulty of registering programmes are the major reasons for not attempting to get its training programmes accredited.

**Table 8.3: Botswana Training Authority (BOTA) accredited training programs**

<i>Name of Company</i>	<i>Accredited Training Programs</i>
Eurostar Botswana	Diamond Polishing
SAFDICO	Certificate in Diamond Processing
	Automatic Machine Polishing
	Preparation
	Brilliantteering
	Cross work

Teemane Manufacturing Diamond Training School Serowe	Fancy Stone Making
	Sawing
	Diamond Polishing

Source: Botswana Training Authority (BOTA). The firm's real names are used in this table as it uses publically information and using the numbering system adapted in this thesis would compromise the anonymity of these firms.

The fact that firms cannot get training rebates, known as training grants, when they train local workers in-house could also account for the low level of accreditation. As was discussed in Chapter 6, Botswana's Training Authority (BOTA) is responsible for accrediting both industry and firm training programmes. The Diamond Hub Office has negotiated for the cutting and polishing firms to be exempted from paying the training levy. As discussed in Chapter 7, the training levy was introduced by the Ministry of Labour and Home Affairs in 2008 and is a tax based on an employer's turnover. It is collected by the government and put into the Vocational Training Fund, which is used to reimburse employers for the costs of training their employees that are Batswana citizens. As the cutting and polishing firms do not pay the training levy, they cannot claim reimbursements from the Vocational Training Fund (BOTA, 2010:192). Since the diamond cutting and polishing firms do not qualify for training rebates, they do not have an incentive to have their training programmes accredited.

BOTA plans to establish training standards in the cutting and polishing industry. In 2010 BOTA decided to establish a Standards Setting Task Force, which would be made up of experts in the area of cutting and polishing skills and would develop "training standards or skills standards" for people working in the sector. BOTA plans to benchmark these standards against other countries that have developed standards in their cutting and polishing industries. According to a BOTA official, once these standards have been

established “they will be registered as Botswana’s standards for training people to work in this sector” (personal correspondence, 26<sup>th</sup> April 2010). However, these standards are yet to be finalised and imposed on the industry. The government sees standards as important to ensuring that all the firms train workers properly by using these standards to monitor firm training. The establishment of training standards is part of the government’s wider reform of the country’s training system. Whether or not firm training is likely to benefit from standards will be discussed in the next chapter.

### **8.1.2. The Formation of Human Capital in Non-Production Jobs**

This section discusses the nature and type of human capital formation that takes place in the firms for non-production jobs or ancillary jobs. As discussed in Chapter 5, these jobs make up around 10 per cent of employment in the firms and because they are not production related, these workers do not need industry-related technical expertise. Instead, these workers need the relevant academic qualifications earned in the education and vocational training system, and/or related experience obtained in other firms. Table 8.4 shows some of the ancillary jobs in the firms and the minimum requirements used for recruitment. It was found that the firms spend less of their operating budgets on training workers for ancillary jobs relative to production-related jobs, not only because their relatively fewer ancillary workers, but more of the necessary skills have already been created by the education and vocational training system or in other firms.

**Table 8.4: Minimum education and training requirements for non-production jobs**

<i>Ancillary Jobs</i>	<i>Minimum Requirements</i>
General Manager	Degree and/or higher and management experience
Accountant	Relevant qualification and experience
Human Resource Manager	Relevant qualification and experience
Logistics Manager	Relevant qualification and experience
Administrative Staff	Secondary Education or a diploma or higher
Cleaners	Basic education



Cooks	Basic education
Security Personnel	Basic education

Source: fieldwork Research

Generally, the firms recruit workers for ancillary jobs using only formal methods, usually through advertisements in the local media. The shortlisted workers are interviewed and selected based on their suitability for the job. They are then trained on the firm's systems and routines. For example, the logistics manager may be trained on how the system the company uses for inventory management. Some of the firms outsource some of the ancillary jobs like cleaning, security and catering to specialised service providers.

Some firms outsource their management functions to a specialised management consultancy, Diamond Manufacturing and Management Consultancy (DMMC). Specialised management companies help the diamond processing firms set up operations in new environments by managing the process involved when a new factory is established, including the development of human resources. The management companies simplify this process for the manufacturing firms and ensure that it is an efficient and effective process. The DMMC was the only management company found to be providing management services to firms in Botswana's cutting and polishing industry. DMMC managed the start-up of the three factories in Botswana, including the development of human resources, as well the firms' on-going production and training activities. The three cutting and polishing factories that DMMC manages represent 20 per cent of polished diamond production in Botswana (Personal correspondence, senior official at DMMC, July 2011). DMMC helped these firms start up their factories by providing them services which included finding training solutions, technology consulting, the development information technology (IT) systems, finance and costing systems and standard operating systems and procedures.

DMMC provides services globally to firms operating in various cutting and polishing centres. It is a subsidiary of I. Hennig & Co. Ltd, which is the world's oldest and largest diamond brokering company and also operates internationally, including in Botswana. DMMC has developed manufacturing knowledge and its own diamond cutting and polishing factory, World Diamond Manufacturer. This factory is based in India and is used to sub-contract diamond manufacturing to its clients. DMMC uses this knowledge and management know-how "to minimize the learning curve and ensure a cost effective and profitable operation" for its clients (Personal correspondence, senior official at DMMC, July 2011). In the past 8 years, DMMC has managed several factories in India, South Africa, China, Namibia and Botswana.

This section has shown that the diamond cutting and polishing firms are currently playing a key role in human capital investments in the industry. The next section therefore discusses the sources of labour turnover in the industry and the strategies that firms use to make firm training more efficient by protecting their investments to mitigate the loss of workers to other firms.

## **8.2.Strategies to Mitigate Against Labour Turnover**

Firms can lose workers to other firms in the industry or they can lose workers to firms in other industries. Labour turnover is currently a real threat to firms in Botswana's cutting and polishing centre because in the absence of a developed industry training system there are still few trained people with the required skills. Thus there is no surplus trained labour supply, a problem deepened by the length of time and effort it takes to train workers. Furthermore, as was discussed in Chapter 4, poaching also leads to an underinvestment in private training in the context of weak industry training institutes. In addition, this research found that there is a perception within the management of firms that some workers see employment in the industry as a shortcut to other career paths, which may lead to labour

turnover once these workers have found better opportunities in other industries. The different sources of labour turnover in the industry are discussed below.

### **8.2.1. The Loss of Workers to Other Firms in the Industry**

The Botswana Diamond Manufacturers Association (BDMA) is a non-profit organisation that was established in 2007 and represents 16 of the 21 firms operating in Botswana. In order to reduce the loss of workers to other firms in the industry, the BDMA oversees a tacit agreement amongst its members to not actively poach workers from each other or hire workers that have worked for other firms. However, it is well known in the industry that not all the members of the BDMA are observing the agreement. During interviews with the Botswana Diamond Valuers and Sorters Union (BDVSU), a union official said that some of the firms that were part of the BDMA did hire workers that had worked for other firms (Interview, Gaborone, 26<sup>th</sup> May 2011). Furthermore, one of the firms that was interviewed said that it had not observed the agreement by hiring experienced workers that had previously worked for other firms. The Managing Director of this firm, Firm 4, said,

“I do not believe in the existence of the no-poaching agreement and I got into trouble with BDMA. But there are no legal obligations not to poach. I think the answer to poaching is that you train people, then you pay them [well] and they will not leave you. No one pays like me; no one has a welfare programme like me. I get applications from workers in other firms and I tell them to resign and wait 2 to 3 months then they can come to me. The industry needs competitiveness and if there is a non-poaching agreement companies will become lax and do little training” (26<sup>th</sup> May 2011).

One firm was more diplomatic when asked about the non-poaching agreement the Managing Director of this firm, Firm 8 said:

"The non-poaching agreement depends on how much more a worker is being offered. I think it is not right to not allow workers to leave but at the same time I think it is not right for other firms to steal workers that the firm has invested in..." (Interview, Gaborone, 18<sup>th</sup> March 2011).

Three of the 12 firms that were interviewed and one firm that was not interviewed<sup>28</sup> do not hire workers that have been employed in other firms. One firm, Firm 9, stated that the reason for this was not necessarily the non-poaching agreement but because they prefer to train workers themselves and that they also would not be able to trust workers from other firms not to leave their firm as well. The Managing Director of Firm 9 said,

"We take people with no skills, I refuse to take someone who was trained in another factory" (Interview, Gaborone, 23<sup>rd</sup> May 2011).

Expanding on the rationale behind this, the production manager of this firm asserted,

"The workers who leave do not necessarily move to other diamond cutting and polishing factories because there is a variation of skills depending on how you were taught. 'Diamond people' don't like employees that were trained somewhere else because this industry is about trust. Trust and loyalty are very important in diamonds because diamonds are a very expensive commodity, so the factory owner has to trust his employees with it. If you left another firm, I cannot trust you. We are training you [the worker] with our most valuable asset and we need to be able to trust you not to leave us" (Interview, Gaborone, 10<sup>th</sup> November 2009).

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<sup>28</sup> According to representatives of the Botswana Diamond Valuers and Sorters Union (Interview, Gaborone, 26<sup>th</sup> May 2011)

It is clear that by leaving their previous employer, the worker may be deemed untrustworthy. However, not all workers who leave cutting and polishing firms go to work for other firms in the industry. Some leave because they have found better opportunities in other industries. This source of labour turnover is discussed next.

### **8.2.2. The Loss of Workers to Firms in Other Industries**

Workers in the diamond cutting and polishing firms may be able to find better opportunities by furthering their studies so they can find white-collar jobs, which may be preferred to the largely blue-collar jobs offered by the cutting and polishing industry. As the Human Resource Manager of Firm 12 explained,

“The perception of the industry needs to change because workers think that they will be paid more because the work with diamonds. Maybe 10 per cent of the trainees take it seriously but some think that it will lead to a white-collar job. Others use it as a way of sponsoring their studies” (Interview, 24<sup>th</sup> June 2010).

The Managing Director of Firm 9 argues that this problem of labour turnover also hinders skills development, “Diamond manufacturing cannot be a temporary job, it has to be long-term for a worker to improve their skills” (Interview, 27<sup>th</sup> May 2010). It is therefore important to see what strategies firms also use to mitigate the loss of workers to both other firms in the industry and to firms in other industries because these strategies are important to understanding human capital development in the firms as they determine the extent to which the firms can retain the human capital that they have invested.

### 8.2.3. Strategies used by Firms to Mitigate the Loss of Workers

The firms have developed a number of strategies to mitigate the loss of workers. The firms use a combination of different strategies, which have been developed through a trial and error process. The next sections will discuss the different of strategies that the firms use both during recruitment and employment to minimise their labour turnover.

#### *Competitive Remuneration*

The first strategy that firms use to mitigate the loss of workers to other firms is offering workers competitive remuneration, which includes both wages and other benefits such as medical aid contributions and a pension fund. Six firms indicated that they mitigated labour turnover by paying their workers competitively relative to other firms in the industry and other firms in the manufacturing sector. Table 8.5 shows the national minimum wage and the average wages in the manufacturing industry for locals and expatriates. The minimum wage for workers in the manufacturing industry is P3.50 per hour (roughly US\$0.57), which is about US\$98.57 monthly (see Table 8.5).

**Table 8.5: National minimum wage and average manufacturing industry wages**

<i>Wages</i>	<i>Local Workers</i>	<i>Expatriates</i>
<b>Minimum national wage</b>	\$3.50 per hour \$98.57 per month (approx.)	-
<b>Average Wages in the Manufacturing Industry</b>	\$211	\$927

Source: Central Statistics Office

The interviewed firms that disclosed their wages paid higher than the minimum wage. Table 8.6 shows the wages in the industry for locals employed in the majority of the production jobs, such as sawyers, bruters and polishers, and the wages of expatriates employed as trainers. The expatriates are employed in more senior jobs and in all the firms they earned more than the locals.

**Table 8.6: Remuneration in the diamond cutting and polishing firms**

<i>Firms</i>	<i>Monthly Wage for Local Production Workers<sup>29</sup></i>	<i>Monthly Wages for Expatriate Trainers</i>
<b>Firm 1</b>	-	-
<b>Firm 2</b>	\$130	-
<b>Firm 3</b>	\$117 - \$613	-
<b>Firm 4</b>	-	-
<b>Firm 5</b>	\$196	\$912 - \$1564
<b>Firm 6</b>	\$157 - \$365	\$456 - \$3911
<b>Firm 7</b>	-	-
<b>Firm 8</b>	\$157 - \$522	-
<b>Firm 9</b>	\$117 - \$390	-
<b>Firm 10</b>	-	-
<b>Firm 11</b>	\$189 - \$698	\$1043 - \$7822
<b>Firm 12</b>	\$130	-
<b>Average for Wages for the Cutting and Polishing Industry</b>	\$265	\$2618

Source: Firm data from fieldwork research and

On average, these firms paid their production workers US\$265, which is slightly higher the average manufacturing wage \$211 for locals. During training workers earn a lower wage, which is closer to the minimum wage and after training their wages increase as workers become more skilled and experienced. The firms use different incentive mechanisms to encourage workers to be productive in order to maximise the productivity of the workers. The firms set daily targets for the number of diamonds each workers should aim to process and these are linked to productivity-related remuneration structures. All the firms interviewed stated that they use performance based pay structures to encourage productivity. There are also penalties for mistakes. For example, Firm 3's workers are charged approximately \$6.50 per mistake to encourage accuracy. Workers also get paid 150 per cent of their wage for overtime, which is in accordance with Botswana's labour legislation.

<sup>29</sup> Wages have been converted from the local currency Pula (P) to US Dollars (\$) using the following exchange rate: \$1 = P7.67 as of 12/05/2012

Furthermore, workers in the cutting and polishing get other non-wage benefits that other manufacturing workers typically do not get, such as, meals provided by their employer and healthcare and pension fund contributions. For example, all the firms interviewed have canteens and provide their workers with free meals every day. Most jobs in the manufacturing sector are temporary, for example confectionary manufacturing firms tend to hire workers seasonally. Due to the temporary nature of their employment, most of the workers in other manufacturing industries do not get employer contributions to pension funds and healthcare schemes. Since free meals, permanent employment and employer contributions are not common practice in other industries within the manufacturing sector, management in the diamond cutting and polishing industry hope that they will contribute to skill retention in the firms.

#### *Recruiting Workers with Lower-Levels of Education*

Four firms stated that they mitigated labour turnover by lowering their education requirements for general production workers like sawyer, bruters and polishers. The reason for this is that when workers are more educated they have more opportunities and are thus more likely to leave the firms. A Human Resource manager at one of the firms explained that, “We hire workers with a low education. The cost is lower to the company because degree holders tend to leave” (Interview, Gaborone, November 2009). A Human Resource Manager in another firm asserted,

“Cambridge [Senior Secondary certificates] holders and graduates have more opportunities, so we look for people with lower results in Form 3 [Junior Secondary Certificates]” (Interview, Gaborone, June 2010).

Concordantly, the Managing Director of Firm 9 said,



“...But we still have people leaving, especially if they are more educated because they normally leave to further their studies. If they are overqualified to start with they will probably leave for better opportunities”

Through the process of trial and error, it is clear that firms which that were initially recruiting more educated general production workers have started recruiting less educated workers to reduce labour turnover as they realised that these types of workers are more prone to leave. As discussed earlier in this section and in Chapter 5, these types of workers do not need a high level of education since their skills and knowledge are developed on the job.

#### *Recruiting Workers based on Particular Personal Attributes*

Six of the firms that were interviewed said they mitigated labour turnover by being very selective during recruitment, looking for particular personal attributes from applicants. The first type of personal attribute that the firms look for during recruitment is workers that have the right personality for job because if the workers are a right fit for the job, this will make them more likely to stay with the firm. As the managing director of Firm 7 explained, “No, staff turnover is not a problem for us, you need to find the right people” (Interview, 21<sup>st</sup> June 2010). Cutting and polishing a diamond is a job that requires a very accurate and patient person that can sit for long hours doing a very repetitive job. The Managing Director of Firm 9 explained that in order to get the right people, he has a very hands-on approach during recruitment, “I interview everyone personally and this has been a very good strategy for the company” (Interview, Gaborone, 9<sup>th</sup> February 2011). As this firm recruits small numbers of workers at a time and has less than 200 employees, the managing director is able to take this direct role in recruitment.

The firms have developed interview questions that help to assess the character of the applicants to determine if they will be a good fit for the job. For example the Managing Director of Firm 4 said, “Recruitment is a trial and error process but we have ways of asking applicants questions to get what we need to know from them” (Interview, 26<sup>th</sup> May 2011). Another important personal attribute that firms look for is loyalty. As was discussed earlier in this section, some of the firms stated that they would not hire workers who have left another firm because these workers cannot be trusted to be loyal. As discussed in Section 8.1.1 most of the firms (8 of 12) choose to use informal recruitment methods for production workers, which mainly involve current workers recommending new workers. This is because the firms feel that they can trust someone who was recommended by a current worker to be loyal to the firm, compared to someone who they recruited “off the street”. This creates an informal institutional arrangement where the new worker knows that if they were disloyal and left the firm to work for another firm within or beyond the industry, this would reflect badly not just on them but also on the worker who recommended them to the firm. Equally, the person who recommended them feels responsibility to keep the worker loyal to the company.

Another way of getting loyal workers is to recruit workers who have fewer job opportunities. Firms do this by either choosing to locate their factories in villages or, in the case of one firm, hiring workers with disabilities. Two of the firms that were interviewed were located in a traditional village or small town. Workers in these rural locations have fewer job opportunities. In one case, the cutting and polishing firm was the second largest employer in the village after the government and this is seen to make workers more loyal to the firm. As the manager of this firm explained,

“This firm is the only cutting and polishing firm in [the village]. The positive side about being away from the other firms is that workers are loyal because they cannot go anywhere else.” (Interview, 14<sup>th</sup> February 2011).

Lastly, hiring workers with disabilities is another way that firms mitigate labour turnover. A quarter of another firm’s staff consists of hearing impaired workers. Since there are very limited opportunities for disabled workers in Botswana, these kinds of workers are considered to be more loyal by management. Significantly, this firm found that the productivity of the hearing impaired workers is on a par, if not higher, than that of other workers, as they are seen to be less easily distracted and more able to concentrate on their work. Indeed, during fieldwork the highest paid worker in this factory, based on productivity, was hearing impaired.

#### *Recruiting Rural Migrants*

Four of the firms that are based in Gaborone stated that they mitigated labour turnover by recruiting workers who are migrants from villages and towns around Botswana. These largely rural migrants who move to Gaborone primarily to take up jobs with a firm are seen as more likely to stay with the firm since they usually have a number of dependents in their home villages, such as their children, grandparents or other relatives, who may depend on their income as job opportunities are limited in rural areas.

#### *Recruiting More Female Workers*

Three of the firms said that labour turnover was mitigated by recruiting female workers. Although these firms do hire male workers, a larger proportion of their workers was female. For example, the General Manager at Firm 2 said that male workers constituted only 37 per cent of the company’s labour force (Interview, 26<sup>th</sup> November 2009). The Human Resource Manager at Firm 12 explained,

We hire more women because they are more responsible and absenteeism is lower compared to men. The women have more responsibilities; most of them are single mothers who have a lot of dependents (Interview, 24<sup>th</sup> June 2010).

These firms see women as being harder working and also as more likely to stay with the firm. As discussed in Chapter 5, production workers need to have amongst other qualities, good dexterity and patience and these firms find women are more likely to have these qualities.

#### *Recruiting Older Employees*

Lastly, three of the firms said that labour turnover is not seen as an acute problem because they recruited older employees, meaning workers that are not recent high school graduates. For example the Managing Director, Firm 9 claimed, “At first I wanted younger staff but they leave so now I am targeting for over 24 year olds” (10<sup>th</sup> November 2009). The Managing Director at Firm 4 said the reason that his firm prefers older workers is that they “... have a better character and team building skills” (26<sup>th</sup> May 2011).

There is, however, a trade-off in recruiting older workers, and some firms prefer to recruit recent high school graduates because they are seen as being more receptive to training. As The Managing Director of Firm 8 explained,

“95 per cent of our workers are young and had never worked before so they are nice and young, so you can mould them. The disadvantage is that labour turnover is higher amongst young workers because they often have the wrong perception of the job. The image of diamonds in the media is that of a high end product, so these workers do not think they will have a blue-collar job where

they will wear a dustcoat. They expect it to be white-collar job where they will wear a suit. But it is our job to educate them (Interview, Gaborone, March 2011).

This section has shown that the firms use various strategies to mitigate labour turnover but it is important to assess the effectiveness of these different strategies at actually minimising labour turnover, this is done in the next section.

#### **8.2.4. The Effectiveness of the Strategies at Alleviating Labour Turnover**

In order to assess which strategies or combination of strategies are effective at mitigating labour turnover in the firms, Table 8.7 shows the different strategies used by firms to mitigate the loss of workers and the degree to which the firms are seen to have experience turnover.

**Table 8.7: Firm strategies to mitigate labour turnover amongst their production workers<sup>30</sup>**

<b>Firms</b>	<b>Competitive Remuneration</b>	<b>Lower Education Requirements</b>	<b>Rural Migrants</b>	<b>Female Workers</b>	<b>Personal Attributes</b>	<b>Older Employees</b>	<b>Labour Turnover<sup>31</sup></b>
<b>Firm 1</b>							Low
<b>Firm 2</b>							Medium
<b>Firm 3</b>							Low
<b>Firm 4</b>							Low
<b>Firm 5</b>							High
<b>Firm 6</b>							Medium
<b>Firm 7</b>							Low
<b>Firm 8</b>							Medium
<b>Firm 9</b>							Medium
<b>Firm 10</b>							Medium
<b>Firm 11</b>							Medium
<b>Firm 12</b>							Low

Key: dark boxes indicate the strategies used by each firm  
Source: Fieldwork Research

<sup>30</sup> Another strategy to mitigate the loss of workers is to be located in a village where there are less job opportunities. Since there are only two firms located in villages, the firms using this strategy have not been disclosed in order to protect their anonymity.

<sup>31</sup> The degree of labour turnover is based on my perceptions developed during fieldwork.

This table shows that the recruitment of rural migrants appears to be the most effective strategy at minimising labour turnover since three of the four firms that preferred to recruit rural migrants were found to have a low labour turnover. Two of these firms also offered their firms competitive remuneration. Another strategy that appears to be effective strategy for reducing labour turnover is selecting workers based on their personal attributes as of the six firms that use this strategy, two had low labour turnover and four had medium labour turnover. Recruiting workers with low education levels is also seems to be an effective strategy as it had contributed to low turnover in two firms and medium labour turnover two other firms. The preference for female workers was moderately successful since it has resulted in a medium turnover in the firms that use this strategy. The table also shows that competitive remuneration alone appears to be the least effective strategy at minimising labour turnover since the only firm that had a high labour turnover only used competitive remuneration to try and decrease labour turnover.

In terms of the combinations of strategies, the following four combinations seem to be the most successful as they have resulted in a low labour turnover in four firms: (1) competitive remuneration plus low educational requirement and rural migrants, (2) competitive remuneration plus rural migrants plus personal attributes and older employees, (3) competitive remuneration and personal attributes, and (4) low educational requirements and female workers.

Overall the research found that although labour turnover does exist in Botswana's cutting and polishing industry it is not a major problem due to the strategies that the firms have developed to mitigate it. The firms have developed these strategies to protect their human capital investments and it is important ask how these strategies impact on the firm training and resulting human capital. This will be done in Chapter 9.

### **8.3. Conclusion**

This chapter has demonstrated that firms are the most important source of training in Botswana's cutting and polishing industry outside of the education and training system. The implications this has on the formation of industry-specific and firm-specific skills will be discussed in Chapter 9. Due to the considerable investments that the firms make in training and given the transferability of some of this training, the firms have developed various strategies to mitigate labour turnover. The employment of migrant workers was found to be the most effective strategy at mitigating labour turnover. The firms' training efforts are mainly diverted at developing production-related human capital used in the factory to cut and polish diamonds. This type of human capital represents the largest share of employment in the firms. The majority of workers employed in the industry are locals who are informally recruited for production jobs. Although all the firms already have local trainers, the majority of trainers in the industry are expatriates that are recruited from the firms' global operations. Based on Becker's (1964) theoretical training framework, reviewed in Chapter 4, the firms are operating in a sub-optimal training environment where they are having to train workers in transferrable skills that could be best formed in industry training institutes. The next chapter will therefore assess the efficiency of the current training infrastructure and its implications on human capital formation in Botswana's cutting and polishing industry.



## **Chapter 9**

### **Assessing the Effectiveness and Future of Human Capital Formation in Botswana's Diamond Cutting and Polishing Industry**

#### **9. Introduction**

This chapter provides an analysis of the research findings discussed in the previous four chapters, within the framework of the literature reviewed in Chapter 4. Chapter 5 outlined the general and specific human capital requirements of the diamond cutting and polishing firms, particularly for direct and indirect production workers. The next three chapters discussed respectively the roles of the national education and vocational training system, industry training institutes and the diamond processing firms themselves, in forming the different types of human capital required by the diamond cutting and polishing industry.

This chapter assesses the findings outlined in these preceding chapters and considers the effectiveness of this training infrastructure in meeting the needs of Botswana's diamond cutting and polishing industry. The skills theory discussed in Chapter 4 showed that technological changes in other craft industries have impacted on human capital requirements in these industries, therefore an assessment of the training infrastructure needs to consider the nature of technological change in the diamond cutting and polishing industry. The chapter therefore looks to the future of human capital development in Botswana's cutting and polishing industry by discussing the increasing role of technology in the industry and how it may influence the human capital required by the firms and the training needed to develop this human capital in the future.

## **9.1.Back to Becker: Human Capital Theory and the Current Training**

### **Regime in Botswana's Diamond Cutting and Polishing Industry**

Becker (1964) theorised the most efficient ways in which general and specific human capital are formed. In light of his theory, this section assesses how efficiently human capital is being formed in Botswana's diamond cutting and polishing industry. The section starts with an assessment of the extent to which the general human capital formed in Botswana's education and vocational training system meets the needs of the diamond cutting and polishing industry. This is followed by an examination of how efficiently industry- and firm-specific human capital is formed through institutional training and in the firms themselves. We have seen in Chapter 5 that diamond cutting and polishing firms are currently playing a major role in the formation of specific human capital in the industry and the key question in this section is therefore whether this is optimal. If not, is there a need for industry training institutes to play a bigger role?

#### **9.1.1. Assessing General Human Capital Formed in the Education and Vocational Training System**

Chapter 5 showed that the diamond cutting and polishing firms require general human capital, such as basic literacy and numeracy, that can be used by a large number of firms in different industries. According to Becker's (1964) analysis, since general human capital can lead to a rise in marginal productivity in many firms, firms will not invest in this type of human capital since they may lose workers to other firms. As a result, general human capital can be formed most efficiently outside the firms in a country's education system. However, he argues that general training can take place in firms when there is a market failure in its provision. Chapter 6 investigated the extent to which Botswana's education and vocational training system produces the general human capital required by the cutting and polishing firms. In Chapter 5, it was argued that there are three different types of workers employed in the firms: direct and indirect production workers and ancillary

workers. Table 9.1 provides a summary of the role of these different types of workers in the firms. Direct production workers are employed in processes like cutting and polishing diamonds, while indirect production workers are not employed directly in production but rather in processes that support production, like the planning and marking of diamonds. Ancillary workers, like administrative staff, perform functions that support the firm's main activity of processing diamonds.

**Table 9.1: Summary of the different types of workers in the firms**

<i>Type of Workers</i>	<i>Description</i>
<b>Direct production</b>	Direct production workers are sawyers, bruters and polishers who are directly involved in the processes used to cut and polish rough diamonds into polished diamonds. For example, sawyers are responsible for cutting diamonds into separate pieces that will become polished diamonds, the bruters give diamonds their basic shape and the polishers use polishing wheels to polish precise, smooth facets which reflect and refract light into and out of the polished diamonds.
<b>Indirect production</b>	Indirect production workers are indirectly involved in production in that although they do not actively cut and polished diamonds they perform tasks that ensure that diamonds are cut and polished according to plan. The roles include production managers, floor managers, planners and markers. For example, the markers and planners examine diamonds to decide on the most economic way for a diamond to be polished.
<b>Ancillary</b>	Ancillary workers are not involved in production in any way, but rather support the main activity - cutting and polishing diamonds. The roles include general managers, human resource managers and accountants. For example the general manager ensures that a firm is a well-functioning business and the accountant makes sure the firms accounts are managed and kept up to date.

Source: fieldwork research

The general human capital required by the firms for the different types of workers was discussed in Chapter 5 and these requirements are summarised in Table 9.2. Direct and indirect production workers require general human capital related to their physical abilities, personal attributes and educational attainment. Ancillary workers are only required to possess the personal attributes and educational attainments relevant to their particular ancillary jobs, although they also require - knowledge on how the company

functions, for example, in terms of its human resource practices. According to Schultz's (1993) characterisation of innate and acquired human capital (discussed in Chapter 4), the physical abilities needed by production workers, such as good eye sight and manual dexterity, are innate and cannot be developed through investments in human capital such as schooling. The personal attributes production workers require, such as creativity or discipline, are also innate qualities but which they can further develop in the education system. The education requirements of all the workers are based on acquired human capital developed through investments in schooling. Production-related workers require relatively less education than ancillary workers and need only primary and secondary schooling to develop basic skills such as literacy, numeracy and low-order computer skills. In comparison, ancillary workers like accountants and human resource managers need to have the relevant higher education qualifications.

**Table 9.2: Summary of the required general human capital**

<i>Categories</i>	<i>Required General Human Capital</i>	
<b>Direct and Indirect Production Workers</b>	<b>Physical Abilities</b>	Good eye sight (stereoscopic vision), manual dexterity, hand-eye co-ordination and endurance (e.g. ability to sit for long periods of time)
	<b>Personal Attributes</b>	Creativity, three dimensional thinking, alertness, awareness, attentiveness, concentration, attention to detail, calmness under pressure, accuracy, flexibility, logic, patience, ability to learn, discipline, responsibility, multitasking, trustworthiness, honesty, loyalty, ability to work in a team, and good work ethic
	<b>Education</b>	Basic literacy, geometry (angles, planes etc.), science, numeracy, basic computer skills and good communication skills
<b>Ancillary Workers</b>	<b>Personal Attributes</b>	Discipline, responsibility, multitasking, good work ethic trustworthiness, honesty, loyalty and ability to work in a team
	<b>Education</b>	Basic literacy, numeracy, computer skills, good communication skills and the relevant higher education qualification

Source: fieldwork research

In accordance with human capital theory, Chapter 6 presented data which shows that, Botswana's education system does produce general human capital of use to the firms for

both their production and ancillary jobs. It was argued that the government has made considerable investments in education, which have led to significant human capital gains since independence. Indeed, it was shown that Botswana's adult literacy rate and education enrolment rates are impressive for a middle-income country. However, it was also found that Botswana's pass rates at the primary and secondary levels of the education system have fallen between 2007 and 2009. Furthermore, it was clear that country's tertiary and vocational training system is still under-developed and that there is a significant pool of unemployed workers who have generally received some education but no formal training. These are the kind of workers recruited by the cutting and polishing firms for the majority of production jobs, as was discussed in Chapter 8. It could therefore be concluded that there are sufficient workers available with the general human capital required by the cutting and polishing firms, particularly for production jobs. However, due to the low pass rates at the end of secondary school discussed in Chapter 6, it is important to investigate whether the quality of the general human capital produced by the education system does indeed meet the needs of the firms.

Although the firms generally acknowledged that they have a large pool of workers to choose from, there was a general sense that the quality of the general human capital amongst low skilled workers in Botswana could be improved. For example, when a managing director at one of the cutting and polishing firms asserted:

“Botswana needs better educated workers. I think what is lacking is basic education. I always tell the government the same answer when they ask me what the problem with skills is in Botswana. But they [government officials] say to me that fixing the education system will take 20 years, and I say that, that it is fine as long as they start today. For example I was trying to explain to my workers the importance of parallel lines on the stones in reflecting light

properly and I asked a worker to draw parallel lines and she had no idea what I was talking about. Another worker thought that if a document is highlighted, it means that things have been crossed out. So what seems to be lacking in the staff is a basic common sense, if I can call it that, which is instilled by a good standard of basic education” (Interview, 14<sup>th</sup> February, 2012).

Thus although the education system produces a large number of people who have received a basic education, the quality of this basic education may not adequately meet the needs of the firms for their direct production workers. Furthermore, in Chapter 6 the higher education system was found to produce more graduates with humanities and social sciences training rather than commercial and technical skills. This has implications for ancillary workers, such as general managers, human resource managers and accountants, who require the specialised forms of education and professional training.

### **9.1.2. Assessing Industry-Specific Human Capital Formed in Industry Institutes**

As a result of the inadequacy of the general human capital formation taking place in the education and training system, we have seen in Chapter 6 to 8, other training activities have filled the gap, as per Becker’s thesis. This section assesses the formation of industry-specific human capital in Botswana’s diamond cutting and polishing industry in light of the theoretical understanding of the most efficient way for these kinds of investments to be made. Unlike training that is not completely firm-specific, this training “increases productivity more in firms providing it”, it may also be useful to “a set of firms defined by product, type of work, or geographical location” (Becker, 1964:26 & 35). According to Becker’s classification, such industry-specific training may be useful to other firms in the cutting and polishing industry as it could increase their marginal productivity. Since firms

may lose workers to other firms if they invest in this type of training, Becker argues that such training would be provided most efficiently in industry training institutes.

Chapter 5 showed that both direct and indirect production workers require industry-specific human capital. All production workers require a set of industry-specific human capital that is general to all production workers in the industry, whatever their particular role in the production process. These requirements are summarised in Table 9.3. This set of industry-specific skills includes the ability to identify and use relevant equipment, knowledge on how to conduct routine maintenance on equipment, an understanding of the economics of diamond processing and a passion for diamonds.

**Table 9.3: Required industry-specific human capital for all production workers (direct and indirect)**

<i>Categories</i>	<i>Industry-Specific Human Capital Requirements</i>
<b>Skills and Capabilities</b>	Ability to organize and manage work area; handle diamond and treat them with care; identify, use and conduct routine maintenance on equipment; insert and remove diamonds from their holder (dop); manage supplies used by worker (e.g. diamond dust, oil, chemicals etc.); maximise the yield of diamonds; follow the parcel paper instructions; check diamonds frequently while processing and examine diamonds to identify problems or natural flaws.
<b>Knowledge</b>	Understand the economics of diamond processing; the various roles of the processing team; the safety guidelines for the hazardous materials used; the characteristics or the crystallography or structure of rough diamonds; the gemmology of polished diamonds (including the four Cs) and Best Practice Policies (BPP)
<b>Personal Attributes</b>	A passion for diamonds and an appreciation of their beauty

Source: fieldwork research

Direct-production workers make up the majority of workers in the factory and they require additional industry-specific human capital, which are summarised on Table 9.4.

**Table 9.4: Required industry-specific human capital for direct production workers**

<i>Categories</i>	<i>Required Industry-Specific Human Capital</i>
<b>All Sawyers</b>	Monitor the machine continuously; take care to ensure each diamond is carefully cemented into the holder so that its axis is exactly parallel to the holder; maximum concentration when inserting the diamond into the holder, respond accordingly if diamonds are not sawing properly; follow procedures when sawing machine is interrupted; periodic maintenance of machines; work safely; prevent damage to diamonds.
<b>Blade (Manual) Sawyers</b>	Saw diamonds with a high powered blade; set up sawing machines; prepare sawing blades, kept or make a groove on the diamonds; step saw large diamonds; monitor up to 20 machines at a time, saw a groove into heart shaped diamonds.
<b>Laser Sawyers</b>	Saw diamonds with a laser beam; programme laser machine according to the planners mark; understand of laser optics.
<b>Manual Bruters</b>	Ability to brute diamonds manually; examine and sort cut diamonds into different groups; gauge the optimum dimensions; maintain equipment and supplies; manage a number of bruting machines at once.
<b>Automated Bruting</b>	Brute diamonds using an automated bruting machine; centre diamonds manually or using the machine's Centring System; programme the automated bruting machine according the parcel papers instructions; stop the machine periodically and check progress being made on diamonds; adjust the machine according to the progress being made; measure the girdle of the diamond periodically so that not too much of its diameter is lost.
<b>Manual Polishers</b>	Polish facets on diamonds to create round brilliant shape or fancy shapes; ability to install, programme and maintain a scaife (polishing wheel); select the right holder for polishing; polish a window facet when instructed by planner/supervisor; set a diamond into a dop, claw and/or a pot; maintain the dop at the correct angle; index and polishing direction; a stable and "light" hand needed to accurately polish diamonds; understand technical drawings from planners and transform them into the physical specifications of the diamond; achieve symmetry when polishing, good geometrical judgement to achieve the perfect angles and size for each facet, know when to reapply diamond dust and oil onto the polishing wheel so that the diamond does not burn; prevent damage to diamonds; correct external characteristics and damage; concentration throughout the work day; sit in one position for long periods of time; good sense of precision and perfection.
<b>Automated Polishers</b>	Programme the automated polisher and set parameters according to the polishing plan; check on diamonds continuously; a little hand polishing experience is recommended; some experience in using a loupe; handle more than one machine at a time.

Source: fieldwork research



As table 9.4 shows, direct production workers need industry-specific skills particular to the role they perform and the type of technology they use. For example, manual polishers and automated polishers need different sets of industry-specific skills. Manual polishers require a lot of technical expertise, such as maintaining the stable and 'light' hand needed to accurately polish diamonds or the good geometrical judgement needed to achieve the perfect angles and sizes for each facet they polish. In contrast automated polishers need relatively less of the knowledge and technical expertise required by manual polishers as they mainly need to know how to programme and monitor the automated polishing machines. Sawyers are another example of production workers whose industry-specific human capital requirements are determined by the technology they use, with blade sawyers having different industry-specific requirements to laser sawyers. While laser sawyers need to understand how to operate laser optics safely to achieve the desired outcomes, blade sawyers do not need this understanding; instead they need to know how to operate a number of high powered blade machines safely, as well how to prepare the blades used by the machines.

Indirect production workers also require industry-specific human capital which are summarised on Table 9.5. This table shows that indirect production workers, like direct production workers require industry-specific human capital that is specific to their particular role in support functions in the factory. This industry-specific human capital is also specific to the type of technology that they make use of. For example, planners and markers need to be able to use the Computer-Assisted Design software that the firm uses to scan and plan each diamond.

**Table 9.5: Summary of the required industry-specific human capital for indirect production workers**

<b>Workers</b>	<b>Required Industry-Specific Human Capital</b>
<b>Production Manager</b>	Manage production on entire factory; oversee the training of new workers; technical production experience in all departments; clear understanding of diamonds, the technology being used and the maintenance of tools and machines; address the queries of floor managers, help find the workers best skill; organise the factory to maximise production.
<b>Floor Managers or Supervisors</b>	Manage production in the floor/department; train new workers; technical production experience in the department; clear understanding of diamonds; the technology being used and the maintenance of tools and machines; address the queries made of production workers in the department; find their best skill, the organisation of the floor to maximise production.
<b>Rough Diamond Procurers</b>	Market dynamics; difference between pure and synthetic diamonds; pricing; consumer trends; competitor awareness; crystallography/gemmology of diamonds.
<b>Rough Diamond Sorters</b>	Characteristics or the gemmology of rough diamonds, differentiate between different types of diamonds
<b>Planners and Markers</b>	Market trends; pricing; the economics of diamond processing; characteristics, or the gemmology and crystallography of rough diamonds; maximise the value of the a diamond considering the best cut; how to avoid inclusions (impurities) and maximise the yield; use diamond planning CAD software; adapt to new technologies.
<b>Quality Checkers</b>	Experience in all the processes; inspect diamonds as they are processed; ensure that the production plan is followed; use all the tools and equipment use to inspect and evaluate diamonds.
<b>Polished Diamond Graders</b>	Advanced understanding of how polished diamonds are graded; understand the GIA grading system; use a microscope and other grading equipment; technical understanding of the Four C's (Colour, Cut, Clarity and Carat); good visual abilities to compare polished diamonds with 'master stones'; differentiate between synthetic and natural diamonds; formal GIA or other gemmology laboratory grading qualifications.
<b>Stock Manager and Controllers</b>	Manage the flow of stock in the factory (i.e. power, glue etc. used during production); using an inventory system; place orders when stock is low to maintain levels.
<b>Maintenance Workers</b>	Technical skills needed for the maintenance and repairs of the relevant machinery and equipment; adherence to safety instruction when operating with hazardous materials.

Source: fieldwork research

Contrary to human capital theory, this research found that the formation of industry-specific human capital for direct and indirect production workers in Botswana's cutting and polishing industry is currently being formed mainly through in-firm training, rather than through industry level training institutes. It was shown in Chapter 7 that institutional training in Botswana's cutting and polishing industry is still embryotic. Currently, the only production-related institutional training provided to Botswana's industry is for graders, who are classified as indirect production workers. However, the institutional training provided for graders is a finishing school since, as discussed in Chapter 7, workers are trained on-the-job first and only go for grading courses once they have developed a certain level of skills and expertise within the firm. Although plans exist to increase institutional training, there is currently no institutional training provided in Botswana for direct production workers, such as cutters and polishers who make up the majority of employment in the firms. Furthermore, the human capital produced by the existing vocational training system is also not sufficient to meet the firms' needs. This is especially evident in relation to technical production jobs, such as laser operators, other technicians, such as electricians and non-production jobs, such as accountants and managers, all of which require formal training in the tertiary and vocational training system. For example a technical director at one firm observed :

“The problem in Botswana is not diamond cutting and polishing skills but other technical skills demanded by the industry like basic electronic skills. I need people who can, for example, repair a television but are not an electrical engineer because they will demand a high salary. The firm still needs to train this person with industry skills so that they can repair and maintain the machinery. But because we cannot find these people with these technical skills we have to send our equipment to Israel for repairing. Another example is the laser technician. He needs to have a background in optics. Maybe he worked in

a camera shop. I would then have to ‘break him in’ and train in him in the finer industry requirements” (Interview, 8<sup>th</sup> May 2011).

Chapter 6 argued that Botswana’s still underdeveloped vocational training system mainly produced skills for the industries such as, construction and automotive repair, which explains why firms struggle to find workers with the technical skills associated with the technologies used in the manufacturing process. Unlike tertiary education, which is administered by the Ministry of Labour and Home Affairs, technical and vocational training falls under the Ministry of Education and Skills Development. This bureaucratic arrangement that separates the education system from the vocational training system has meant that skills produced in the vocational system do not necessarily meet the training needs of the country. Indeed, in a recent report the government identified a mismatch between the supply and demand for vocational skills (BOTA, 2010). Since the technology and equipment that the firms use is similar and often identical, the technicians that use these types of technologies, such as the laser cutters, need to have skills that are largely industry-specific. The technical director at Firm 3 that employs a laser technician that had previously worked for another firm said,

“If there was a technical school for the industry and the firm was looking to hire a laser technician we would look for that person in [the technical] school instead of in other factories. We would look for someone at [the technical] school who is willing to learn and we would teach them how the high-tech equipment in the firm works”

The limited availability of workers with the relevant technical skills means that the firms have no choice but to train workers in these technical skills in-house. In order to address the supply and demand mismatch between the vocational training and education system

and the economy, in 2010 the Botswana Training Authority identified a list of priority vocational skills and developed strategies to fast track their development. The study started by identifying sixteen critical vocational skills and from these, six were assessed as being of the highest priority for development (see Table 9.6). The lack of these vocational skills was considered to be a constraint to development since they were currently in the highest demand but the shortest supply.

**Table 9.6: Identified critical and priority vocational skills**

<i>Sixteen Critical Skills Identified</i>	<i>Six priorities identified for fast track development</i>
Transport Operations	Transport Operations
Technical/ Vocational Teaching	Technical/ Vocational Teaching
Hospitality and Catering	Hospitality and Catering
Electricians	Electricians
Radio/ Electronics/ Computer Engineering (including telecommunications)	Radio/ Electronics/ Computer Engineering (including telecommunications)
<b>Diamond Cutting/ Polishing and Jewellery Making</b>	<b>Diamond Cutting/ Polishing and Jewellery Making</b>
Masonry and Bricklaying	
Refrigeration and Air Conditioning	
Carpentry/ Joinery	
Basic Nursing and other Health Related	
Welding and Fabricating	
Marketing/ Sales	
Plumbing and Sheet metal	
Machine Tool Repair/Fitting	
Motor Mechanics	
Agriculture	

Source: BOTA (2010)

As Table 9.6 shows, skills in diamond cutting and polishing, as well jewellery making, were identified as being among the country's priority vocational skills. In line with the government's beneficiation policy (discussed in Chapter 2), BOTA's the study saw the downstream diamond industry as of great strategic importance to Botswana's development.

Furthermore, the study expected that the demand for these skills would rise in the future as employment in the downstream diamond industry is projected to double to around 6,000 employees by 2016. The study also proposed a strategy for how diamond cutting and polishing and jewellery making skills could be developed to meet current and future demand. This strategy supported the introduction of institution-based training in the diamond cutting and polishing industry as it was recognised that nearly all training in the industry currently takes place inside the firms, as was argued in Chapter 8.

BOTA's priority vocational skills study was written in consultation with the major stakeholders in the diamond cutting and polishing industry such as Botswana's Diamond Manufacturers Association, which represents the majority of cutting and polishing companies in the country, and the government's Diamond Hub, which regulates the industry. Based on these consultations the study found that:

“The Diamond Manufacturing Association envisages an ideal scenario in which there would be a very close working relationship between employers and an institution that provides training in basic skills, as well as in specialist areas, as indicated by the industry. In this scenario individual students would be ‘groomed’ in response to specific company demand; attached to that company during training; and ‘offered’ as an employee to the company after graduation”  
(BOTA, 2010, 192)

While BOTA's study found that there was strong support for institutional training, my research found that there were some reservations within the industry. For example, a senior official at DeBeers was of the view that training should be done in-house because of the particular preference of each manufacturer for how training should be done. Nonetheless, there is undoubtedly a widespread belief that institutional training can play some role in

the industry's human capital formation. For example, a senior manager in a leading cutting and polishing firms in India said:

“Diamond cutting and polishing skills are personalised, they rely on human judgement and are therefore hard to standardise. However, there is a role for a basic course to get the basic knack and for workers to do a career seminar prior to the course.” (Interview, Mumbai, May 2011)

However basic training would have to be appropriate to the firms' needs. As the DeBeers manager remarked with reference to the Harry Oppenheimer School in South Africa,

“If you ask any manufacturer in South Africa they will tell you that they prefer to recruit someone from the street and train them themselves because the training given by the Oppenheimer School is not appropriate” (Interview, London, August 2011).

Institutional training would clearly have to be done with close consultation from the firms. When a manager at one of the firms was asked if he would outsource training to the India Diamond Institute's (IDI) proposed school in Botswana a manager said “We have been taking people with no knowledge so it would be easier if they were trained” (Interview, Gaborone, March 2011). He went on to explain that the company had met with IDI officials and explained which areas of training that they would like IDI to focus on. For example, the firm identified planning skills as a priority area as they difficult to develop and find even with their group of companies. He also added that IDI can make trainees aware of what the job will entail so that the workers expectations are realistic.

Another reason why there were some reservations with regards to institutional training is with regards to the firms' recruitment process. As discussed in Chapter 8, some firms prefer workers recommended by current workers because they know that they can 'trust' them. So this is a 'personal' aspect of the recruitment process and could make firms reluctant to hire workers from a training school. Indeed a manager at a firm explained that he would not hire workers trained at a school because this could be a way for crime syndicates to place workers in the firms (Interview, Gaborone, May 2011). Therefore training institutes could take this aspect into account by working with the firms to source trainees.

Apart from proving basic industry training, institutional training can play a role in providing industry-specific training for workers who are already employed in the firms and need advanced industry training. For example, all the firms that have sent their graders for advanced grading courses at gem-testing laboratories only sent them for these courses once they had first been trained with the basics of grading in the firms. Institutional training for grading skills is viable and necessary because it is these gem-testing laboratories that provide grading certificates and the firms need to have workers who understand how these laboratories will grade their diamonds in order to ensure that the production process achieves the desired quality of diamonds.

However, it has been two years since BOTA's study was concluded and so far it has not resulted in any tangible outcomes. As a result of BOTA's study the Diamond Hub has advanced plans to start institutional training. This institutional training is planned to take place through diamond-related courses that will be offered at the Oodi College of Applied Arts and Technology, a technical and vocational college, which opened in May 2012. The training programmes at the college will include jewellery design and manufacturing foundation courses. These courses will be offered as part of the India-Africa Diamond



Institute discussed in Chapter 7. However, as a result of a bureaucratic conflict between the Ministry of Education and the Diamond Hub, these courses are yet to be introduced. The Diamond Hub has an institutional agreement with the IDI to provide the training at the college. Yet the Ministry of Education and Training, which administers the college, feels that it was excluded from this process and seems reluctant to cooperate. For example, in June 2012 the Ministry of Education and Skills Development refused to sign a Memorandum of Agreement with the IDI and a ministry official was quoted as saying, “This college does not belong to the Diamond Hub, but the Ministry of Education. How can you [The Indian Diamond Institute] finalise everything with the Diamond Hub?” (Mmegi News, 8<sup>th</sup> June 2012). It is therefore currently unclear when the diamond-related courses will be introduced at the college.

It is clear then, that industry-specific training is predominately taking place in the firms and not through institutional training in Botswana’s nascent diamond cutting and polishing industry. According to Becker, this is to be expected when an industry is new to a country:

“Training in a new industrial skill is usually first given on the job, since firms tend to be the first to be aware of its value, but as demand develops, some of the training shifts to school” (Becker, 1964:37).

There is clearly space for a greater degree of institutional training for production-related human capital in Botswana’s cutting and polishing industry since basic skills and knowledge used in each of the production processes are the same across all the firms in the industry. The very existence of the no poaching agreement (discussed in Chapter 8) testifies to the existence of industry-specific skills that all the firms can make use of. These types of skills would be best produced in industry training schools but due to the early stage of the development of Botswana’s diamond cutting and polishing industry, this type

of training is currently taking place in the firms. Although it is clear that a proportion of the human capital required by the firms is industry-specific, the firms also require workers to have firm-specific human capital. The next section therefore assesses the efficiency of firm-specific human capital formation in the diamond cutting and polishing industry.

### 9.1.3. Assessing the Formation of Firm-Specific Human Capital

Unlike industry-specific training, firm-specific training is specific because, according to Becker (1964:26), it is “training that has no effect on the productivity of trainees that would be useful to other firms”. Thus this type of training should take place in the firm and be paid for by the firm because it will only lead to productivity increases in the firm. The firm-specific human capital required by the firms was discussed in Chapter 5 and is summarised in Table 9.7.

**Table 9.7: Firm-specific human capital requirements**

<b>Workers</b>	<b>Required Firm-Specific Human Capital</b>	
<b>Production-Related Workers</b>	<b>Product Specifications</b>	Facetting sequence Number of facets Patented cuts Grading targets Customer specifications Notation used on parcel papers
	<b>Technical Processes</b>	Company preferences on exactly how each process is done The parameters used Frequency of Quality Control Maintenance and repair procedures Trainer’s training preferences Routine maintenance on equipment
<b>All Workers</b>	<b>Company policies</b>	Human Resource Policy Health and Safety Policy Dispute resolution procedures Remuneration policy Leave procedures Work breaks (lunch provision procedures etc.) Promotion policies

		Internal recruitment policies Pension contribution Medical care contribution and provision
	<b>Company Systems</b>	Information Technology Systems Inventory control system Security System

Source: Fieldwork research

Production-related workers need firm-specific human capital with regards to the firm's production specifications and preferences on technical processes. For example, if a firm has a patented diamond cut that they produce, the production-related workers need to learn the production specifications used to achieve the patent cut. Similarly, if the firm's customers have some product specifications for the polished diamonds, then production-related workers need to know these specifications. Firm routines are an important determinant of the human capital required by the firms. Firm-specific training involves building on industry-specific human capital using the firm's unique routines, as a technical director at one of the firms stated:

“The cutting and polishing skills are like Lego; the components are uniform or the same across firms in the industry, the only difference is how you put them together. The [cutting and polishing] skills consist of the same ideas and principles. The difference amongst the firms is the sequence that they chose to use the skills in. For example, the amount of quality control that is done depends on the individual firm” (Interview, Gaborone, May 2011).

He went on to explain that in his firm quality is crucial because they produce triple excellence diamonds, which are polished diamonds with the highest grading (excellent) for their proportions, polish and symmetry. Consequently, quality control is done in between all the processes to ensure that the diamond is being polished according to plan. The same

worker in the quality control department checks the diamond after each process in order to ensure consistency. This firm has developed routines around quality control to ensure that a high quality product is produced at the end of the manufacturing process. As was discussed Chapter 4, a firm's unique routines are an important determinant of their firm-specific human capital requirements and this has been found to be the case in the diamond cutting and polishing industry. For example, a production manager in India explained that firm training is still important in India even though the firm can recruit workers that have received institutional industry training

“You have to adapt them [the worker] to the company's processes even if they come with skills. You blend the persons knowledge with the company's systems”  
(Interview, Gaborone, May 2011).

Although, as was argued in the previous section, institutional training could provide for industry-specific training, the role of the firms in forming firm-specific human capital is crucial. Indeed as Becker (1964) suggests, firm-specific training does indeed take place in the diamond cutting and polishing firms. Since firm-specific human capital is mainly around the routines used by the firms and these routines are unique to every firm, the firms are best placed to produce this type of human capital. All workers that are recruited by a firm receive in-house training to familiarise them with the company policies and systems. For example, production workers receive training on firm preferences for particular production specifications and the technical processes used to achieve these specifications.

Firm-specific training takes place in-firm, as one would expect based on Becker's (1964) general analysis but the firms in Botswana diamond cutting and polishing have also been found to play a bigger role in training than Becker suggested would be most efficient. Since the firms are currently training workers in transferable industry-specific skills this

raised issues around labour turnover, as was shown by the different strategies that firms were found to be using to minimise labour turnover (detailed in Chapter 8). Under the current training regime the diamond cutting and polishing firms may not recover their costs of training if workers leave, this may result in them underinvesting in industry-specific training. This poses a real threat to the realisation of the Botswana government's vision to build competitive downstream capabilities. If this vision is to be realised, institutional industry training needs to play a bigger role in human capital formation in the diamond cutting and polishing industry to insure that optimal investments in training take place.

The role of institutional training is especially important in light of the increasing role of technology taking place globally in the cutting and polishing industry. As was discussed earlier in this chapter, one area where there is much larger firm level training activity than one would expect is in the area of knowledge and experience building for technical skills needed to operate machines using new technologies, such as lasers. As was argued in Chapter 4, technological innovation has changed the nature of the human capital required in many craft-based industries, like metalworking and the textiles industry, by undermining the tacit knowledge and skills developed over many generations. It is thus important to understand how technology is changing in the cutting and polishing industry and the impact these changes will have on the human capital and training required by the firms in the future. The next section therefore looks towards the future of training in Botswana's diamond cutting and polishing industry by describing the technological changes that are taking place in the global diamond cutting and industry. The section also considers how these changes will impact on the human capital required by the industry and the training needed to produce this human capital.

## **9.2.Global Technological Change and the Development of Downstream Capabilities in Botswana's Diamond Cutting and Polishing Industry**

This section starts by describing technological changes in the diamond cutting and polishing industry and the opportunity these changes have presented for Botswana, a latecomer to the industry, which has been able to leapfrog to the most efficient technologies in the industry.

Since the 1980s the global diamond cutting and polishing industry has undergone a technological revolution that has impacted on the craft of cutting and polishing diamonds developed over many centuries. Traditionally the knowledge and techniques used in diamond processing were craft skills kept as a trade secret and passed down through close relations from one generation to another. Diamonds were polished in cottage industries, which were usually family-owned businesses, so that the knowledge and skills could be closely guarded in an industry well known for its secretive culture. As described by Joan Younger Dickson in 1965 (quoted in Watermeyer, 1980:4), “Different ways still prevail in different centres, different secrets in different families. Its is a clannish world, this world of diamond cutters, the kind of society which sociologist call primitive because of its reliance upon tradition, rituals and relationships rather than books, laws and officials”. As part of this culture, the skills and knowledge used in the cutting and polishing process were largely tacit and little was written down. So for many centuries the cutting and polishing process was seen as “black art” which was not widely understood by outsiders (Klein, 2005:39). Even when early innovations took place in the industry, they were also closely guarded:

“In the centuries that followed, there have been individual, carefully guarded innovations in cutting machinery and methods, resulting in a much higher quality end product. As might be expected, the flush of innovation in Europe and the coming of the Industrial Revolution in the nineteenth century brought radical changes in lapidary<sup>32</sup> machinery. And yet, individual lapidaries and cutting guilds managed to keep the nature of this new machinery as well as the techniques for using it very secret” (Klein, 2005:29).

The early innovations that took place as a result of the industrial revolution included the use of the steam to power machinery used in the cutting and polishing process. Steam power was a revolutionary technology, which had an economy-wide impact. Early innovations also included the transformation of the organisation of production in the industry from production in cottages industries to factories, as seen in other industries such as textiles. This facilitated the increase of the division of labour, which in turn decreased the level of skill needed by the individual workers. The breaking down of the production processes into a number of specialised jobs meant that some tasks could be performed by relatively unskilled labour, reducing the costs. This process undermined the level of craft needed by each worker, as Klein (2005:90) argues,

“Today’s method of operation is a far cry from the talent shown by individual diamond fashioners of past centuries. Back then, one man fashioned a beautiful diamond by doing all of the work required in cutting and polishing – from the rough stone to the completed gemstone. Very few diamond cutters today ever achieve this level of talent”.

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<sup>32</sup> Lapidary is the art of cutting and polishing precious stones

As was described in Chapter 5, in today's modern mass production factories workers in diamond cutting and polishing factories specialise in a specific task to increase productivity. Traditionally, apprentices needed to know everything and would have to be trained for over 5 years. But because workers in a typical factory only need to master one process, an apprenticeship is not necessary. Instead, a short probationary period is used when production workers are trained in diamond cutting and polishing firms (Klein, 2005:91), like those in Botswana, as was shown in Chapter 8. The change in the organisation of production from cottage industries to factories also led to incremental innovations that resulted in new processing techniques. The secrecy around these new techniques often delayed their development and diffusion. For example, when the sawing technique was developed to cut diamonds using diamond dust applied on a spinning blade it took over a century to develop because the technique was kept secret (Watermeyer, 1980).

As a result of the secretive culture in the industry the cutting and polishing process changed little for decades and it was not until the late 1970s that a quiet technological revolution started to take place as more of the knowledge in the industry became codified. As a result, the cutting and polishing industry advanced more from 1980s onwards than it had in the preceding 100 years (Caspi, 1997:102). This revolution changed cutting and polishing processes by introducing technologies such as laser, computer numerical control (CNC) tools and computer aided design (CAD) and automatic systems to the industry. Today, diamonds can be cut using laser technology, designed using CAD software, manufactured using CNC tools, polished using manual and automated machines and the different functions of the firms, such as design, production and finance, are coordinated using computer-integrated manufacturing (CIM) systems.



Furthermore, technological change in the industry is still very dynamic with new technologies being developed at a rapid pace. For example, in 2011, Sarin, a leading diamond technology developer, introduced the Galaxy 1000 Scanner, which is used in diamond planning to scan through diamonds to show their internal structures and flaws. Previously, planning machines were only able to give a 3D scan of the exterior of diamonds. A “window” facet would have to be polished on the diamond, in order for the planner to see inside the rough diamond. This is a time consuming process, which also decreases the value of a diamond by reducing its weight. But with the new technology, this process is not required. New technologies like the Galaxy 1000 are improving profitability in the industry and they have also enabled manufacturers to process diamonds that would not have been feasible using the traditional manufacturing techniques (Caspi, 1997:102).

However, the key disadvantage to the new technologies is their cost. “The capital investment required to start a modern factory is usually 10 times more than that needed to set up a traditional factory” (Caspi, 1997:121). Due to the cost of the new technologies they are mainly used in the production of larger, more valuable stones. By improving the quality of polished diamonds produced by the industry, the new technologies have enabled manufacturers to meet increasing consumer demands for higher quality polished diamonds.

Botswana’s industry has been able to skip less advanced and efficient technologies and leapfrog to the most modern and efficient technologies. The leapfrogging literature in industrial development deals with the question of how latecomer countries can catch up with industrialised countries and their level of industrialisation. As Soete (1985:416) argues,

“...the opportunities offered by the international diffusion of technology to jump particular technological paradigms and import the more, if not most,

sophisticated technologies that will neither displace the capital invested nor the skilled labour of the previous technological paradigm, constitute one of the most crucial advantages of newly industrializing countries in their bid for rapid industrialisation.”

Exemplifying this, a production manager at one of the firms in Botswana, which also has a factory in India, said, “The technology is changing and in Botswana you can train people on new machines, in India people are stuck with old technologies” (Interview, Gaborone, May 2011).

However, there is a significant constraint on technology adoption in Botswana due to the limited level of local infrastructure development. For example, Botswana has constraints in the provision of electricity and the Internet. Internet provision is unreliable and slower during peak times. The firms are multinational and often need to send big files to their parent companies, particularly when they are planning stones. Most of the firms have centralised information and technology systems, which are administered in other countries and are accessed through the Internet. Unreliable electricity supply is a problem that affects the whole economy and not just the cutting and polishing industry. The cutting and polishing equipment and technology is operated with electricity and without a generator, power cuts would stop the production in the whole factory and possibly damage some machines. Most of the factories have generators to ensure electricity supply. This not only increases the costs of doing business in Botswana but also constrains the firms’ ability to use the latest technologies efficiently. For example, the Galaxy 1000 machine requires that it is connected to the internet and electricity at all times; if it loses connection during the planning of a diamond it will cost the firm both time and money as the machine needs to start again and the liquid that the diamond is immersed in would need to be replaced. However, the government is currently implementing plans to improved Internet and

electricity supply by supporting the laying of deep-sea fibre optic cables and building a new power plant. It is therefore anticipated that the infrastructure constraint will ease over time.

The next section considers how the technological changes taking place in the diamond cutting and polishing industry will impact on the industry's human capital requirements.

### **9.2.1. The Impact of Technological Change on Industry's Human Capital Requirements**

The technological changes that are taking place in the diamond cutting and polishing industry are similar to changes that have already taken place in other industries like metalworking and printing, as discussed in Chapter 4. Unlike these industries, the diamond cutting and polishing industry is at an earlier stage of these technological changes. The digitisation of design and optimal cutting and polishing paths has been already implemented in the industry's production processes using digitally-controlled laser cutting machines, automated polishing machines as well CAD software. As was discussed in Chapter 4, these technological changes mean that the industry's human capital requirements will likely be more for front-end digital design and machinery servicing than in manual shop floor production. However, while these changes will not completely supplant the human capital used in shop floor production, it will significantly reduce the demand for the traditional craft skills used in the production processes.

The technological changes taking place globally in diamond cutting and polishing have two important implications on the future of human capital formation Botswana's diamond cutting and polishing industry. The first implication is the need to train for future skills as well as traditional craft skills. This will require different general industry-skills such diamond planning (or design) using the new technologies. This will also increase demand

for industry skills that cut across sectors, such as software programming and machine maintenance. In order to meet these future demands, industry-specific human capital development can no longer be confined to the firm level. As Botswana's education and training system is struggling to meet the current needs of the firms, any institutional industry training efforts need to not just produce the skills that have traditionally been required but also the skills that are increasingly needed to operate the new technologies in the industry. In order for Botswana to create a successful, technologically advanced cutting and polishing industry, the institutional industry training needs to play a bigger role in developing human capital. This will aid the country's ability to absorb the new technologies introduced by the industry. As Keller (1996:199) argues absorptive capacity at the national level is crucial because "technology is only implementable if the labour force has built up the corresponding skills" and that "sustained growth gains are only forthcoming, if in addition to the arrival of new technologies, also skills are accumulated at a higher rate". So a country's ability to absorb new technologies depends on its possession of the related skills and knowledge, or human capital.

The second implication of technological change in Botswana's diamond cutting and polishing industry is on the key value in the diamond cutting and polishing industry that is added in the planning and marking stage, which determines the most economic way that diamond can be processed. As was discussed in Chapter 4, the introduction of Information and Communication Technology (ICT) coupled with computer-integrated manufacturing (CIM) enables design and planning to take place remotely, even in another country from where production is being undertaken. If Botswana is to capture this importance source of value-added, then planning and marking needs to occur in Botswana. Since Botswana's cutting and polishing firms are multinational companies, their IT and inventory control systems are Internet-based. This enables the firms' head offices to obtain information on the progress of production so that their sales and marketing functions can be planned using

up-to-date production figures. In the same way front-end design, or the planning of the optimal cuts, can easily take place at the head offices, limiting the value-added by the firms in Botswana. The policy implications of this finding will be discussed in the next chapter.

### **9.3. Conclusion**

This chapter combined Becker's (1964) human capital thesis with the skills literature on technological change. This enabled an investigation into the effectiveness of the current human capital formation in Botswana's diamond cutting and polishing industry and how technological change will impact on the industry's human capital requirements in the future. This research argues that there is a need for government to address industry level institutional training to support its vision to make Botswana's diamond cutting and polishing sector viable and a world leader internationally. This cannot be achieved if the industry is still 'demanding' by default that firms do all their own training. The need for more institutional training is even greater given the impact technological change is likely to have on the diamond cutting and polishing industry's human capital requirements. Botswana is trying to position itself higher up in the international diamond value chain and the pace of technological change is helping it to do this by enabling the country to leapfrog to the most efficient technologies in the industry. However, in order to realise this opportunity, there is a real need for more industry level training as the new technological skills required are not firm-specific but industry-specific due to the similarity of technologies being adopted in the firms.

## Chapter 10

### Conclusion: Research Findings and Policy Implications

#### 10. Introduction

Since the first agreement between DeBeers and the Government of Botswana was signed in 2005, Botswana's nascent diamond cutting and polishing industry has made progress in creating the downstream capabilities that can continue to benefit the country when diamond mining stops being profitable in the country due to imminent resource depletion. Diamond cutting and polishing firms have created over 3000 jobs in Botswana, representing a tenth of employment in country's manufacturing sector. As this research has shown, the firms are also playing the greatest role in developing Botswana's downstream processing capabilities mainly through on-the-job training where locals are taught the craft by experienced master craftsmen (see Figure 10.1).

**Figure 10.1: Locals employed in one of the diamond cutting and polishing firms**



Source: <http://www.mmegi.bw/index.php?sid=4&aid=1841&dir=2012/July/Monday23>

This research argues that for Botswana to build competitive downstream capabilities, firm training needs to be reinforced with more institutional industry training, especially in light

of increasing role of technology in the diamond cutting and polishing industry. These and the rest of research findings are discussed in this chapter as well as their implications on policy.

### **10.1. Summary of Research Findings**

This research aimed to inform the Botswana government's vision to build the downstream capabilities needed to capture more value added in the diamond industry through the processing of diamonds. To do so, this research investigated how efficiently training is producing the human capital required in Botswana's diamond cutting and polishing industry. In order to answer this overarching research question, the following specific research questions were addressed:

1. What is the theoretical understanding of human capital formation through training, in the firm, in industry level training institutes and in the wider education and vocational training system?
2. What are the skills and knowledge required by the diamond cutting and polishing industry?
3. How is human capital formation taking place in Botswana's diamond cutting and polishing industry?
4. How does training in Botswana's nascent diamond cutting and polishing industry compare with training in a developed diamond processing centre?
5. How does training in Botswana's diamond cutting and polishing industry relate to the theoretical understanding of training?
6. With reference to how technology has changed skills requirements in other traditional craft industries, will the increasing role of technology in the diamond cutting and polishing manufacturing processes impact on the human capital and therefore training required by the firms?

Responding to these research questions, the rest of this section summarises the key findings detailed in each chapter.

### *Chapter 2 - Are Diamonds Really Forever? Botswana and the Diamond Industry*

For the last four decades, Botswana, the world's largest producer of rough diamonds by value, has enjoyed sustained resource rents arising from its large endowment of diamond resources and these have underwritten the country's growth since independence. As the diamond revenues that Botswana earns from diamonds are expected to decrease significantly in the next two decades due to resource depletion, the government has used the leverage that it derives from the country's diamond endowment to force DeBeers, the country's largest diamond producer, to help it deepen value added through forward linkages. It is therefore as a result of government-will rather than market forces that 21 cutting and polishing factories are operating in Botswana.

The government's vision is that the country creates diamond cutting and polishing capabilities that can continue to benefit the country when diamond mining ceases to be profitable. However, creating cutting and polishing skills appears to be a difficult task as the world's leading diamond processing centres, such as Belgium, Israel and India, have only attained the pre-eminence by accumulating a large pool of highly-developed skills over a significant period of time. As large accumulations of human capital explain the dominance of major players in the diamond cutting and polishing industry, the success of the Botswana's entry into diamond processing hinges on the development of the necessary capabilities, skills and knowledge.

### *Chapter 4 - Human Capital: Rents, Formation and the Impact of Technological Change*

This chapter argued that although resource rents can explain the leverage that Botswana's government had to start the country's diamond cutting and polishing industry, these rents



will decrease as resource depletion nears. It is therefore important that Botswana develops human resource rents in the diamond cutting and polishing industry to build competitiveness in the industry.

Human capital theory around training was reviewed in order to understand how Botswana could develop human resource rents in the diamond cutting and polishing industry. Becker (1964) provided a useful to understanding on how training for general and specific, industry- and firm-specific, human capital can take place most efficiently. Based on Becker's (1964) analysis, general human capital, such as basic literacy and numeracy, can be used by a large number of firms in the economy and it is formed most efficiently in the country's wider education and vocational training system. Industry-specific human capital can raise productivity in more than one firm in an industry and it is therefore formed most efficiently in industry-level training institutes. Firm-specific human capital only raises productivity in one firm and as result it can be formed most efficiently through firm-level training. Becker's (1964) framework provided an analytical tool for assessing the efficiency of human capital formation in Botswana's diamond cutting and polishing industry.

This chapter also reviewed skills literature around technological change and found that technological change has lead to changes in the human capital required by workers in other traditional craft industries by undermining tacit craft skills in favour of more modern skills, such computer-related skills and maintenance skills.

#### *Chapter 5: The Human Capital Requirements of the Diamond Cutting and Polishing Firms*

This chapter investigated human capital requirements in the diamond cutting and polishing firms in order to enable an assessment of whether the required human capital is being formed by Botswana's education and vocational training system, industry training

institutes, and the diamond cutting and polishing firms. The chapter argued that workers in the firms fall into three categories: direct production workers, indirect production workers and ancillary workers. Direct production workers are responsible for processing rough diamonds into polishing diamonds. Indirect workers play a role in supporting the production workers, by either preparing diamonds for the production line or ensuring that production workers have all the inputs that they need to keep working. Ancillary workers are not involved in production, instead they mainly work in administrative roles in the firms. All workers require general human capital as well as firm-specific human capital whilst direct and indirect production workers also require industry-specific human capital.

Direct production workers make up the majority of workers in the firm and they play an important role in determining the firm's human resource rents. These workers need a high degree of technical capabilities that are developed over time. Minimum labour turnover is therefore crucial to determining that workers develop a high level of skills. Although indirect workers do not work directly in production, their human capital requirements do consist of some technical production skills and knowledge. The level of skills required by workers in the cutting and polishing firms varies according to the type of work they do directly or indirectly in the production process. Ancillary workers do not need to have technical production skills and knowledge; instead they need the relevant education, training and or experience.

#### *Chapter 6: Human Capital Formation in the Education and Vocational Training System*

This chapter investigated extent to which Botswana's education and vocational training system produces the general human capital required by the diamond cutting and polishing firms. The chapter found that the government spends a considerable amount on education, which has led to significant human capital gains since independence. Indeed, Botswana's adult literacy rate and education enrolment rates, except for tertiary and vocational

training, were found to be impressive for a middle-income country. However, Botswana's pass rates at the primary and secondary levels of the education system were found to have fallen in recent years. Furthermore, Botswana's tertiary and vocational training system was found to still be underdeveloped and producing either a low level or no technical skills relevant to the cutting and polishing industry. However, the chapter found that due to high unemployment Botswana has a significant pool of unemployed workers that have generally received some education and no formal training, which based on education and training attainment of the workers in three cutting and polishing firms, was found to be the main type of general human capital that the industry employs.

#### *Chapter 7: Human Capital Formation in Diamond Cutting and Polishing Industry Training Institutes*

This chapter argued that the development of Botswana's diamond cutting and polishing industry can be divided into three phases: the pre-production phase, production start-up phase and the production ramp-up phase. During the pre-production phase the firms were still starting their factories in Botswana with production started during the production start-up phase of the industry's development. In the current production ramp-up phase, the firms are increasing their production capacities in line with their business strategies. The chapter found that overall, firm utilisation of formal institutional training during all three phases was very low. Based on current plans to establish more industry training institutes one would however expect institutional training to increase in the future. The chapter also found that international experience from India shows that the development of industry training institutes can result from government effort.

#### *Chapter 8: Human Capital Formation in the Diamond Cutting and Polishing Firms*

This chapter found that diamond cutting and polishing firms are the most important source of training in Botswana's cutting and polishing industry. The chapter found that the

majority of workers employed in the industry are locals who are informally recruited and work in production jobs. Although it was found that the firms already have local trainers, the majority of trainers in the industry were found to be expatriates recruited from the firms' global operations. The firms' training efforts were found to mainly be in the development of production-related human capital.

The chapter also found that due to the considerable investments that the firms are making in training and given the transferability of some of this training, the firms have developed various strategies to mitigate labour turnover. Amongst these different strategies, the employment of migrant workers was found to be the most effective strategy at mitigating labour turnover.

#### *Chapter 9: Assessing the Effectiveness and Future of Training in Botswana's Diamond Cutting and Polishing Industry*

This chapter showed that this research combined Becker's (1964) human capital thesis with the skills literature on technological change. This enabled the research to conduct an investigation into the effectiveness of the current human capital formation in Botswana's diamond cutting and polishing industry and how technological change will impact on the industry's human capital requirements in the future. This research found that there is a need for government and to address industry level institutional training to support its vision to make Botswana's diamond cutting and polishing sector viable and a world leader internationally. This chapter argued that this could not be achieved if the industry is still 'demanding' by default that firms do all their own training. Therefore this research argues for a greater need for more institutional training especially given the impact technological change is likely to have on the diamond cutting and polishing industry's human capital requirements. Botswana is trying to position itself higher up in the international diamond value chain and the pace of technological change is helping it to do this by enabling the

country to leapfrog to the most efficient technologies in the industry. However, the chapter argued that in order to realise this opportunity, there is a real need for more industry level training as the new technological skills required are not firm-specific but industry-specific due to the similarity of technologies being adopted in the firms.

## **10.2. Policy: Implications, Knowledge Gaps and Implementation**

This section discusses the policy implications of these research findings and the knowledge gaps that need to be filled in order for policy to properly address these findings.

### **10.2.1. Policy Implications**

From the perspective of general skills formed in the education and vocational training system, Botswana's diamond cutting and polishing industry's needs are being met in terms of the availability of workers with the basic skills required by the firms. Due to the considerable investments that the government has made into the education system and Botswana's high unemployment level, there is a large pool of workers with basic general skills that the firms can recruit from. However, there is a need for the education and vocational training system, to not only improve the quality of the basic general skills produced by the system but to also produce more general technical skills required by the diamond cutting and polishing industry. Apart from improvements in the quality of basic general human capital and the availability of general technical skills, in terms of the overall availability of general skills, there are no major obstacles faced by the industry that need to be overcome by policy.

There is however a crucial need for policy to consolidate institutional industry training in Botswana's diamond cutting and polishing industry. The government needs a clear policy on the creation of capabilities for the cutting and polishing industry, particularly industry-specific skills. The government needs to play a key role in fast tracking the development of

institutional training in order to improve the efficiency of the training infrastructure in Botswana's diamond cutting and polishing industry. For example, the proposed Africa-India Diamond Institute needs to be prioritised by addressing the current bureaucratic disputes that are stalling its establishment. Furthermore, more training providers need to be attracted to the country in order to create a competitive training environment. To do this, training providers need to be assured about the longevity of Botswana's diamond cutting and polishing industry. The government needs to therefore play an active role developing institutional training by providing information on the industry's training needs, coordinating any efforts by the private sector to meet these needs by establishing institutes, and reassuring industry of the government's long term commitment to the industry's future development. It also needs to ensure that there are adequate financial incentives for firms to use the industrial training centres, without wasting funds on free riding. For example, the firms could start paying the training levy in order to qualify for training rebates.

At the firm level there is uneven performance for training, with only a limited number of firms found to be utilising institutional training, and there is therefore a need for policy to even-out this performance by providing the firms with incentives that can deter firms from under-investing in training. These incentives could be training subsidies, which would act as a 'carrot' that would encourage the firms to invest more in training. However, the government needs to be aware of the problem of free riding, where the government could be made to cover costs that the firms would have been willing to incur anyway. The government needs to have clear firm training performance requirements and set clear targets for skills transfers in the cutting and polishing industry. It is also important that more of the firms' training programmes are accredited by Botswana's training authority. The government needs to collect data, perhaps through the training authority, on the number of locals being trained and the types of skills they are being trained in. The government then needs to use the such information to monitor firm training performance

and punish firms found to still be undertraining even with the subsidies in place, using a ‘stick’ like reducing the rough diamond allocations.

In line with the skills literature, the increasing role of technology in the diamond cutting and polishing industry was found to be changing the skills mix needed by workers. Technological change provides Botswana with a real opportunity to leapfrog to the most efficient technologies. However, the idea of leapfrogging does not take into consideration the implications of the changing human capital requirements on the latecomer’s absorptive capacity for the new technologies. In future workers will require fewer traditional craft skills and relatively more new technology skills, like computer programming and laser skills. As a large component of the new skills are industry-specific, any future institutional responses to industry-specific training need to take technological change into account and incorporate the skills the new technologies require into training programmes. With the advance of computer integrated production systems, the high value front-end work may increasingly be done in developed cutting and polishing centres like Israel and Belgium. As these activities can be undertaken through the Internet, they could automatically set up and control machines in Botswana, this poses a threat to the value-added taking place in Botswana. If Botswana is to capture optimal value added from the cutting and polishing industry, the government needs to ensure that front-end activities, like the planning of optimal diamond cuts, take place in the country.

In the earlier phases of the industry’s development in Botswana a large percentage of the firms used to export their rough diamonds to be planned and marked abroad before re-importing them for polishing. It is difficult to monitor this process since it is hard to tell if the diamonds that are being sent out are the same ones returning as they may have been sawn into separate pieces. Furthermore, as was discussed in Chapter 5, this is a critical part of the manufacturing process as it determines the most profitable way for the firm to cut a

rough diamond and it is a very knowledge intensive process. The Government's Diamond Hub noticed that the amount of rough diamond being exported for planning and marking was not decreasing over time and saw this as an indication that very limited skills transfer was taking place in this area. The firms were then asked to demonstrate skills development of their local employees, in order to ascertain that they were indeed trained in planning skills and that their skills were increasing over time. The firms complied and starting training local workers in planning skill and since then only a small number of the firms still require to export and then re-import their rough diamonds to be planned and marked abroad. A government official said,

“Before may be only three or four firms were planning and marking in Botswana and now only three or four firms export their rough diamonds to be marked and planned in other countries.” (Interview, Botswana, March 2011).

In the same way that government monitoring responded to diamonds being exported for marking and planning, it needs monitor and respond to diamonds being planned and marked through the internet.

#### **10.2.2. Knowledge Gaps**

Policy needs to be knowledge-based. The government, together with the private sector, needs to understand the trajectory of the industry in general and the labour market in particular. This section therefore aims to identify the relevant information that needs to be collected, both abroad and locally, to enable an evidenced-based policy response to improve the efficiency of the training infrastructure in Botswana's diamond cutting and polishing industry.



Botswana needs to look abroad to more developed diamond cutting and polishing centres such as Israel and Belgium, to discover the steps they are taking to maintain their competitive advantage, especially with regard to policies that are being introduced in these countries to improve training in the light of the new technologies that are being developed in the industry. As a key characteristic of India's diamond cutting and polishing centre, as discussed in Chapter 8, was the presence of a large informal sector, the government needs to understand the role that this aspect of the industry could have in the industry's performance, particularly with regard to training.

Botswana also needs to look abroad to understand the threat that the increasing role of synthetic diamonds poses to the future of Botswana's diamond cutting and polishing industry. How are more developed diamond cutting and polishing centres dealing with the threat of synthetics? How are they using advanced synthetic identification techniques and pursuing marketing strategies aimed at promoting and upholding the image of the natural diamond market?

Furthermore, as the Government of Botswana's vision is, over time, to develop downstream capabilities that go beyond the diamond cutting and polishing industry to more value-added activities further downstream in the diamond value chain. There is a need therefore to understand other high value-added activities in the value chain, such as marketing and retailing. Diamonds manufactured in Botswana present a real marketing opportunity for Botswana's diamond cutting and polishing industry. A 'manufactured at source' niche marketing strategy may create a competitive advantage for the country's industry if these diamonds are found to be preferred by consumers that are conscious of the development impact of their diamond purchases in producer countries. Currently, individual diamond cutting and polishing firms in Botswana have started developing jewellery brands and marketing campaigns that aim to capitalise on the story of Botswana

and its diamonds, but there is a need for a concerted effort led by the government to develop and lead a wider campaign that would benefit not just individual firms but the entire industry.

In recent years, the source of demand in the retail industry is shifting from developed countries, such as the USA, to emerging economies, such as like China and India, as a result of both the current economic recession that has decreased demand in developed countries and the increased demand from the growing middle-class in China and India. There is a need to understand the implications of their shift in demand for the global diamond cutting and polishing industry, particularly as these countries are both major diamond manufacturers.

There is also a need for information to be collected domestically to aid the formulation of a relevant policy response aimed at improving the training infrastructure in Botswana's diamond cutting and polishing industry. Firstly, firms need to collect data through regular audits of their training needs so that policy can keep up with firms' training needs over time. It is also important to understand how the entrance of new firms will affect the industry's labour market since five more cutting and polishing firms were recently licensed in 2011. Policy makers also need to collect information that can help them assess whether the quality of the institutional training provided by current and future industry training institutes meets the demands of local industry and how it can be attuned to the needs of the firms. Furthermore, policy needs to go beyond addressing the training needs of the firms by investigating how other factors such as the provision of Internet and transport may be constraining the industry's development.

Moreover, it is imperative that this knowledge generation is not a once-off activity, but rather a continuous process. Therefore, the collection of information abroad and locally

that can help inform policy needs to be conducted at regular intervals in order for the policy response to continue being relevant as the global and local industries change over time.

### **10.2.3. Policy Implementation**

Once these knowledge-gaps are addressed, an evidenced-based policy response can be formulated to improve the efficiency of the training infrastructure in Botswana's diamond cutting and polishing industry. However, having the relevant policy is not sufficient as it is only through the appropriate implementation of these policies that any tangible outcomes in the industry will be realised. Thus it is important to understand the circumstances under which policy implementation is effective. Rodrik (2004) argues that policy gets implemented when there is an effective dialogue process between the government and industry and that this process is much more important than what is on paper in policy documents. Within this framework, Rodrik (2004:2) contends that industrial policy should be formulated in a way that optimises its "contribution to economic growth while minimizing the risks that it will generate waste and rent-seeking". The central argument of his paper is that "the task of industrial policy is as much about eliciting information from the private sector on significant externalities and their remedies as it is about implementing appropriate policies" (Ibid: 3). In this model, industrial policy is seen as a discovery process, through a deliberate collaboration between the government and the private sector, and even labour. Through this collaboration the impediments to industry development and the interventions that can remove them are identified (Rodrik, 2004).

Thus policy is best seen as a dialogue that depends on trust between the public and private sector. It is therefore important to consider whether there is currently an effective collaboration and adequate trust between government and the cutting and polishing industry. In order to understand the current relationship between the government and the

industry, this research asked both government and industry respondents their views on both government and corporate policy in terms of their respective visions, key programmes, coherence and the capacity both the government and firms to implement their policies. These findings are discussed next.

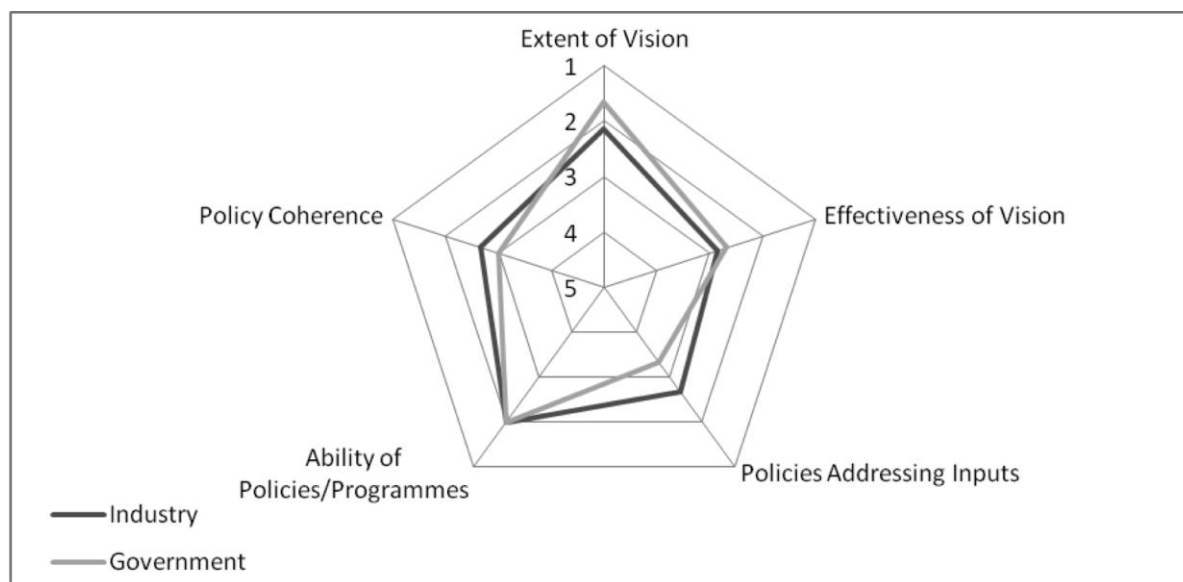
On the government side, the Diamond Office and Diamond Hub, both of which fall under the Ministry of Minerals, Energy and Water, oversee the implementation of policies in Botswana's diamond cutting and polishing industry. The Diamond Office employs three public officials who were previously Minerals Officers employed by the Department of Minerals. The Diamond Hub also employs three officials and the most senior official is the Diamond Hub Coordinator who is the key driver of the government's plan to become a serious downstream player in the diamond industry. The Diamond Office is responsible for inspecting diamond exports, issuing Kimberley Process certificates and monitoring the activities of the companies by doing 6 monthly audits together with DTC Botswana. The Diamond Hub is responsible for developing programmes to implement the government's vision to create a downstream industry.

The research found that in terms of the role of the Diamond Hub in the industry, there appears to be a clear correlation between the opinions of government and the cutting and polishing firms. To illustrate this, Figure 10.2 shows industry and government opinions on the different aspects that determine the effectiveness of government policy, such as the extent to which the government has a vision for the industry, the effectiveness of the vision, the extent of coherence with government policies, and the ability of the different policy and programmes to deliver on the government's vision.

The figure shows that the government and industry responses were largely aligned. Both industry and the government agreed that the government does indeed have a vision for the

industry but that this vision was currently only slightly effective. The limited effectiveness of the vision was traced largely weaknesses in policy coherence, particularly in addressing the supply of inputs, including human resources to the industry.

**Figure 10.2: Industry and government opinions on various factors that determine the effectiveness of government’s policy**



Sample size: 3 government respondents, 7 industry respondents (5 manufacturing firms and two brokers)

Key: 1 – Extremely effective, 2 – Very effective, 3 – Moderately effective, 4 – Slightly effective and 5 - Not at all effective

Source: author’s research

However, many in the industry felt that the Diamond Hub was very approachable and willing to listen. For example, a manager of a cutting and polishing firm said,

“Policy is working with and not against the industry, the culture is very open and we can recommend things to the Diamond Hub”.

Both industry and government respondents agreed that government policies have some ability to develop the industry. Thus there appears to be a good, trusting relationship

between government and industry. However, it is not clear if the Diamond Hub has the capacity to design and implement programmes for the cutting and polishing industry as this is still a fairly new industry and officials have not yet developed in-depth industry knowledge. To illustrate this Table 10.1 shows industry and government responses on government's capacity to implement its policies.

**Table 10.1: Industry and government opinions of government's capacity**

	Government (n=3)		Industry (n=7)	
	Yes	No	Yes	No
Do you think the government has the <i>capacity</i> to implement its policies for the cutting and polishing industry?	100%	0%	29%	61%
Do you think the government <i>really wants to</i> ?	100%	0%	86%	14%
Do you think issues of <i>personal integrity</i> amongst the relevant government officials affect the Government's ability to implement its policies for the industry?	0%	100%	0%	100%

Source: author's research

Although 100 per cent of the government respondents said that government has the capacity to implement its policies for the cutting and polishing industry, 61 per cent of the industry respondents said that the government does not have the capacity to implement its policies. Although the Diamond Hub may understand the government's plan to create a cutting and polishing industry, in order to best implement the plan the officials employed in the office also need an understanding of the business-side of the industry. Despite the views on the government's capacity, 86 per cent of the industry respondents said the government really does want to implement their policies and all the respondents said there are no issues of personal integrity amongst the relevant government officials, which affect the government's ability to implement its policies for the industry.

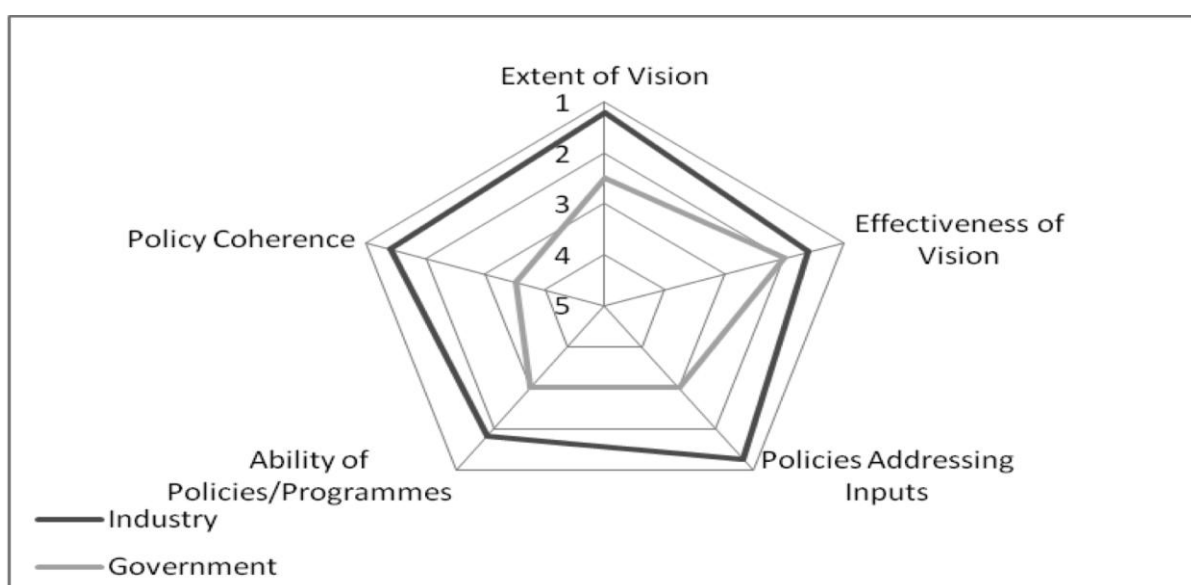
Another aspect of implementation that is lacking relates to the creation of linkages and synergies between the Diamond Hub and the other relevant hubs that the government is currently trying to develop, such as the Innovation Hub, the Education Hub and the Transport Hub (discussed in Chapter 2). Although the Transport Hub has made considerable progress in addressing some of the key infrastructure gaps that existed when the industry was started, the Education Hub has not developed industry training to develop sufficient enough industry-specific skills for the industry. Similarly, the Innovation Hub has not managed to attract companies to undertake industry focused research.

Besides government policy, corporate policy also plays a very important role as it is with the 21 manufactures that the government aims to build cutting and polishing capabilities that will benefit the country when the upstream industry no longer exists. However, the degree to which the manufacturers' business models are long-term will determine whether or not they stay in Botswana when they no longer receive their rough diamond allocations from the country. The biggest threat to the government's vision is the depletion of diamonds in the next couple of decades (if no new significant diamond deposits are discovered), after which the government cannot assure the manufacturers of rough diamond allocations. If the manufacturers are only in Botswana for rough diamonds, it is fair to conclude they will leave when diamonds are depleted. This is especially likely as their costs of operating in Botswana are currently relatively higher than in low cost centres like India and China. Furthermore, history has proven that the cutting and polishing industry is very mobile, moving to where government incentives are high and costs, particularly labour costs, are low.

It is therefore possible that the manufacturers' visions or business models may be short term and are not aimed at benefitting the country in the long-term. For example, their

visions for skills development and, therefore, their human resource policies may not be aimed at developing high level skills but only enough skills to serve their production in the short-term. Figure 10.3 shows industry and government opinions on the effectiveness of corporate policies in the diamond cutting and polishing industry.

**Figure 10.3: Industry and government opinions various factors that determine the effectiveness of corporate policy**



Sample size: 2 government respondents, 5 industry respondents (manufacturing firms)

Key: 1 – Extreme effectively, 2 – Very effective, 3 – Moderately effective, 4 – Slightly effective and 5 - Not at all effective

Source: author's research

The industry and the government's views differ on the extent to which the manufacturers have a vision, which was defined as a unique business model for Botswana's cutting and polishing industry. The industry respondents believed that they have a vision to a very high extent whilst the government respondents believed that the manufactures have a vision only to a moderate extent. The manufactures' global business models are centred on becoming world leaders in their industry while their local business models were centred on cutting diamonds in the most efficient manner, creating jobs and imparting locals with



cutting and polishing skills. The firms said that their contribution to Botswana was not beneficiating the country's diamonds but also to donating to various charitable causes, as they believed that giving back to the community was also of a form beneficiation. It therefore appears that the industry's definition of beneficiation is much broader than adding value to diamonds and creating employment and skills as it also includes a form of corporate social responsibility (CSR).

With regard to the efficiency of its firm's local business models, the industry respondents were of the view that they were highly effective in maintaining long-term profitability while the government respondents felt they were slightly less effective. This could indicate doubt from the government on the longevity and sustainability of some of the manufactures' business models, since the government respondents were of the view that the corporate policies could only deliver on the industry's business models to a moderate extent whilst the industry respondents felt that these policies could deliver to a high extent. Government respondents views on the limitations of the policies reflect what they saw as weak coherence of the corporate policies. Government respondents felt that the corporate policies did not always cohere with their objectives, it was said that while the firms' objective was to transfer skills, not all the firms had detailed skills development programmes. The government respondents said the company policies were weak with regards to skills development but that there was variation amongst the companies with regards to their skills development programmes. This they said was illustrated by some companies who were serious about training sending workers for off-firm training, whilst other companies whom they viewed as not being serious about training only used on-the-job training.

Table 10.2 shows industry and government views on the capacity of the firms to implement their corporate policies.

**Table 10.2: Industry and government opinions of corporate capacity**

	Government (n=2)		Industry (n=5)	
	Yes	No	Yes	No
Do you think the companies have the <i>capacity</i> to implement their corporate policies?	100%		100%	0%
Do you think they <i>really want to</i> ?	50%	50%	80%	20%
Do you think issues of <i>personal integrity</i> amongst the relevant company employees affect the companys' ability to implement their policies for the industry?	100%		40%	60%

Source: author's research

Both industry and government respondents felt that the companies had the capacity and skills to implement their corporate programmes. But only half of the government respondents felt that the companies really wanted to implement these policies, indicating that they were issues of personal integrity amongst the relevant company employees that affect the companies' ability to implement their policies for the industry. Even amongst the companies, 80 per cent of the respondents said that the companies really wanted to implement their policies, with 40 per cent of industry respondents saying that personal integrity was a problem amongst some employees in their companies. Thus capacity was not seen to hinder the implementation of corporate policies, rather company will and the motives of some employees were identified as the problem.

These findings show that while there does appear to be a trust relationship between the government and the industry, the industry has slightly more trust in the government than the government has in the industry. Government appears to be open to industry views and working together with the industry to implement policies. However, the government seems to be wary of the industry and its motivations for being in Botswana, which are seen to be

reflected in their corporate policies, particularly with regards to training. In order for industry and government to continue in this policy process together, their relationship needs to be strengthened. Attention therefore needs to be given to supporting and sustaining the trust relationship between the government and industry. If the Botswana government and the diamond cutting and polishing industry are able to continue to work more effectively together, then they can better address knowledge gaps and design and implement the appropriate policies needed to improve the efficiency of the current training infrastructure in Botswana's diamond cutting and polishing industry.

### **10.3. So... will Botswana have more than a “Big Hole” in the Future?**

Going back to my earlier thoughts on Kimberley's “Big Hole”, the question I still have is whether in generations to come Botswana will have more than a “Big Hole” to remind it of its time as a major diamond producer. Unlike in Kimberley, will future generations in Botswana sing a different song that perhaps will go like this,

*“The diamonds of our country, were sent across the seas”*

*“But we did not let them go, instead we strived to show, that our skills are more to these”*

*“O let us learn, this praise to earn”*

*“Per labores ad honores” [Through labour comes honour]*

But in attempting to answer this question, I find that only time can tell as the outcome depends on whether Botswana is able to build competitive and sustainable downstream capabilities over the next two decades that can outlive diamond mining. It is only through the formation of these downstream capabilities that in generations to come Botswana will have not only a “Big Hole” but also a legacy of diamond cutting and polishing skills that can continue to benefit the country long after the last diamonds have been profitably

mined. As this research has shown, this depends on strengthening institutional training in Botswana's diamond cutting and polishing industry so that it is human capital rather than natural resources that will produce the rents upon which Botswana's future development can be secured.

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